AMERICAN ENGINEER AND RAILROAD JOURNAL.

(ESTABLISHED IN 1832.)

THE OLDEST RAILROAD PAPER IN THE WORLD.

The American Railroad Journal, founded in 1832, was consolidated with Van Nostrand's Engineering Magazine, 1887, forming the Railroad and Engineering Journal, the name of which was changed to the American Engineer and Railroad Journal, January, 1893.

PUBLISHED BI-WEEKLY AT NO. 47 CEDAR STREET, NEW YORK.

M. N. FORNEY, . . . Editor and Proprietor.
FRANK J. FRENCH, . . . Business Manager.

Entered at the Post-Office at New York City as Second-Class Mail Matter.

SUBSCRIPTION RATES.

Postage prepaid, { U. S., Canada and Mexico, . . $2.50 / Single Copies, ...10 / Foreign Countries, ... 3.50

Remittances should be made by Express Money-Order, Draft, P. O. Money-Order or Registered Letter.

The paper may be obtained and subscriptions for it sent to the following agencies:
Chicago, Post Office News Co., 217 Dearborn St.
London, England, Sampson Low, Marston & Co., Limited, St. Dunstan's House, Fetter Lane, E. C.
Berlin, Germany, W. H. Kühl, 73 Jäger St.
Paris, Bandry et Cie., 15 Rue des Saints-Pères.

NEW YORK, DECEMBER 12, 1895.

EDITORIAL NOTES.

ON January 1 THE AMERICAN ENGINEER AND RAILROAD JOURNAL and the *National Car and Locomotive Builder* will be consolidated into one publication, with the title AMERICAN ENGINEER, CAR-BUILDER, AND RAILROAD JOURNAL. The form of the paper will then be changed, and it will be issued monthly thereafter, and the subscription price will be reduced to $2 per year. Mr. M. N. Forney will have charge of the editorial department, with competent assistance.

IN another column we publish a description of a mammoth locomotive running-shed that has been built in England for the accommodation of 180 locomotives. We know of nothing comparable to it in point of capacity, and it is certainly a strong argument in favor of the running-shed over the roundhouse that so large a number of locomotives can be accommodated in so small a space. If there were no arguments against this method of housing, however, there would be no reason why all American roads should not immediately fall into line and adopt that type of construction. The American and English locomotive superintendents cling each to the national type, and it will probably be some time before either will be adopted in the territory of the other. The American and the compartment type of car have been contending for the supremacy for many years, with indications at present pointing toward the probability that the American car will win; the American outside cylinders for locomotives are also steadily gaining ground, though English designers are still placing them in an inclined position, and it remains to be seen whether the roundhouse will survive as the fittest shelter for a locomotive, or will be compelled to give way to the running shed.

MUCH has been said for and against the storage battery at different times during the last few years, and there is one error that many authors have made—viz., not classifying the use to which the battery is to be put, but treating its uses as a whole and attempting to draw conclusions therefrom. The uses of batteries may be divided into two general classes: First, where the weight of the battery is a factor; and, second, where weight may be disregarded. The former mode of application, in which the battery is used for individual motor cars, launches, and the like, have given far from satisfactory results, except possibly in a few special cases, and therefore we will not consider this class. In the second class is the battery in connection with a central station, to take up the fluctuations of load, to keep on supplying energy when the engines are shut down for short periods, etc. Now the question arises, Is the storage battery the best and most economical means of accomplishing this end? or would it be more economical to use some agent other than the battery? The opinion of an engineer is usually strongly in favor of the battery or much opposed to it, few taking up the question on its merits. Among several papers presented to the American Institute of Electrical Engineers on Wednesday, November 20, there was only one, by Nelson W. Perry, entitled "The Storage Battery or the Gas-Engine as an Auxiliary," which took up the question seemingly on its merits.

Mr. Perry's paper, to which we refer, appears in this number.

RAILROAD RACING.

THE last number of this journal contained an article with the above title, in which the subject of cars for the fastest trains was discussed. It was there shown that the weight per passenger of the cars in the train which made the fast run between New York and Chicago last September was 1,656 lbs. per passenger, and this was compared with the weight of the cars on the New York Elevated Railroad, which is only 500 lbs. for each seat. The possibility of making cars suited for fast-train service of much less weight than those which are now used was propounded, and it was suggested that "if such a reduction of weight was effected that it would make the problem of increased speed a much easier one than it now is." The discussion of locomotives for such service was deferred and will now be taken up.

The essentials in a locomotive for making fast time are, first, a sufficient load on the wheels to produce adhesion on the rails; second, an adequate supply of steam, and third, mechanism for turning the wheels at the required speed.

There is, of course, no difficulty in having sufficient weight on the driving-wheels, which might be and sometimes is provided by an otherwise useless mass of cast iron made into the form of a foot-board. The trouble usually is, if the boiler is made large enough to supply steam, and the turning mechanism is made adequate to perform its duties, that there is too much weight on the wheels. It is, of course, true, too, that every pound of weight in a locomotive which is not needed for adhesion, the generation of steam, or for turning the wheels, is an impediment and not an aid in making fast time.

If the weight of the cars for carrying 218 passengers was reduced one-half, it could not be assumed that the locomotive for hauling it at a given speed could also be reduced in the same proportion, for the reason that the weight of the passengers would remain the same, and so would their stature, and this requires a certain height and width and space in the cars. Or, in other words, their dimensions cannot be reduced even if their weight is, or, at any rate, it cannot be brought below certain limits. The atmospheric resistance—which is an important element in fast running—could, therefore, be but slightly changed if the trains are made lighter.

The locomotive and tender, therefore, to make, say, 60 miles an hour, with a train of cars weighing 180,500 lbs., must weigh somewhat more than 102,000, or half that of the New York

Central engines—how much more we will not now attempt to indicate. Supposing, though, that we want to make an average speed of 70 miles an hour with our light train instead of 60, what kind of an engine will we need ?

It is sometimes hastily assumed that if a locomotive is doubled in size it will run twice as fast. If the wheels were made 12 ft. in diameter instead of 6 ft., and the cylinders and boiler in like proportion, and the wheels were turned the same number of revolutions in a given time, it seems at first as though the speed of the locomotive would be doubled. It is somewhat like the hypothesis that if an elephant could jump as far as a grasshopper does in proportion to his weight, the larger beast could cover many miles in a single leap. The fallacy of this reasoning was pointed out by Ruskin in a note in "Modern Painters,"* in which he said :

"Many persons have thoughtlessly claimed admiration for the strength—supposed gigantic—of insects and smaller animals, because capable of lifting weights, leaping distances, and surmounting obstacles of proportion apparently overwhelming. Thus, the *Formica Herculanea* will lift in its mouth and brandish like a baton sticks thicker than itself and six times its length, all the while scrambling over crags of about the proportionate height of the Cliffs of Dover, three or four in a minute. There is nothing extraordinary in this, nor any exertion of strength necessarily greater than human, in proportion to the size of the body. For it is evident that if the size and strength of any creature be expanded or diminished it can maintain exertion, or any other third term resultant, remains constant—that is, diminish weight of powder and of ball proportionately and the distance carried is constant, or nearly so. Thus, a grasshopper, a man and a giant 100 ft. high, supposing their muscular strength equally proportioned to their size, can or could all leap, not proportionate distance, but the same or nearly the same distance—say 4 ft. the grasshopper, or 48 times his length ; 6 ft. the man, or his length exactly ; 10 ft. the giant, or the tenth of his length. Hence, all small animals can, *cæteris paribus*, perform feats of strength and agility, exactly so much greater than those to be executed by large ones, as the animals themselves are smaller ; and to enable an elephant to leap like a grasshopper he must be endowed with strength a million times greater in proportion to his size Now, the consequence of this general mechanical law is, that as we increase the scale of animals, their means of power, whether muscles of motion or bones of support, must be increased in a more than proportionate degree, or they become utterly unwieldy and incapable of motion ; and there is a limit to this increase of strength. If the elephant had legs as long as a spider's, no combination of animal matter that could be hidebound would have strength enough to move them ; to support the megatherium we must have a humerus a foot in diameter, though perhaps not more than 2 ft. long, and that in a vertical position under him, while the gnat can hang on the window frame and poise himself to sting in the middle of crooked stilts like threads, stretched out to ten times the breadth of his body on each side. Increase the size of the megatherium a little more and no phosphate of lime will bear him ; he would crush his own legs to powder. (Compare Sir Charles Bell, 'Bridgewater Treatise on the Hand,' p. 296, and the note.) Hence there is not only a limit to the size of animals in the conditions of matter, but to their activity also ; the largest being always least capable of exertion ; and this would be the case to a far greater extent, but that nature beneficently alters her proportions as she increases her scale, giving, as we have seen, long legs and enormous wings to the smaller tribes and short and thick proportion to the larger."

Suppose that we had two locomotives capable of hauling such light trains as have been suggested at 60 miles per hour, and that two trains ran side by side on parallel tracks, obviously if these two trains and locomotives could be transmuted into one, there would be no mechanical or logical reason why the single or larger train could run faster than the two light ones.

To increase the speed of a train from 60 to 70 miles per hour, let us see what is required. In a table of railroad train resistances, which is perhaps as reliable as any,† the resistance per ton (of 2,000 lbs.) at 60 miles per hour on a level road is given as 27 lbs. At 70 miles it is said to be 34.6 lbs. The consumption of steam, therefore, at the higher speed would be in somewhat the same proportion—that is, it would be as 34.6 : 27. The celebrated No. 999 class of engines, on the New York Central Railroad, have 1,930 sq. ft. of heating surface, and a grate area of 30.7 sq. ft. The half of these two quantities would be 965 and 15.35 respectively. As the amount of steam which will be consumed at the higher speed compared with that required at 60 miles per hour will be as 34.6 : 27, therefore the amount of heating surface and grate area required will be in like proportion, or 1,236 and 20 respectively. It is true that a locomotive with that amount of steam-generating capacity would weigh somewhat more than half as much as the No. 999, which would, of course, increase the total weight of the train, so that somewhat more heating and grate surface would be required for the higher speed with the light train. Such a locomotive could, however, be readily built.

Let us see what would be required if we should attempt to accelerate the speed of the heavy train in like proportion ; but before doing so, it should be said that our reasoning is of a hypothetical character, and is not based upon any quantitative data, and is only intended to indicate the principles which must be complied with when the average speed of trains is increased.

If we should attempt to make an engine to haul the heavy train at an average speed of 70 miles per hour instead of 60, or, in other words, accelerate its speed one-sixth, the grate area and heating surface would require to be increased in the proportion of 34.6 : 27, so that we would require 2,473 sq. ft. of heating surface and 40 ft. of grate area. This would, of course, give us a heavier engine, which excess would be added to the total weight of the train, which, in turn, would react on the engine, making some additional weight necessary. It is safe to assume, then, that we would need somewhat more than 2,500 sq. ft. of heating surface ; and if the fire-box is constructed as that of No. 999 is made it would require to be about 10 ft. long.

It is submitted that most locomotive builders would rather undertake to furnish an engine to haul the light train at 70 miles an hour than to undertake to make time with one as heavy as the Empire Express ordinarily is. In other words, it is very much easier to increase speed by reducing the weight of trains than it is by increasing the capacity and weight of locomotives. If the report which is current that some of the heavy 10-wheeled fast passenger engines now in use have at times manifested a propensity for leaving the track be true, it may be that that form of construction will not be available if an increase of speed is attempted with such trains as are now employed on the fastest schedules. If not, and faster time is demanded without a diminution of weight of train, the type of engine best adapted to the service becomes a very interesting problem to all designers and superintendents of locomotives.

On another page an engraving is given of the new express engine recently built by the Baldwin Locomotive Works for the Chicago, Burlington & Quincy Railroad, which at this juncture is very interesting. The three essential requirements in locomotives for making fast time, as stated in the beginning of this article, are sufficient adhesion, an adequate supply of steam, and effective rotating mechanism for turning the driving-wheels. In the locomotive referred to the latter are placed under the middle of the boiler, and can therefore be loaded with as large a proportion of the weight of the machine as may be desirable. For producing steam, grate area and heating surface are required. From our illustration it will be seen that the plan of construction shown permits of as wide a fire-box being used as may be desirable, of course not exceeding the total width available for engines and cars. In the present instance the width of grate adopted is 5 ft., so that to have 40 sq. ft. of area, which our calculations show

* Vol. II., p. 57, second American edition.

† See "Catechism of Locomotive."

would be hypothetically required, it would need to be only 8 ft. long instead of 10 ft., as it would be if placed between the wheels.

This plan of engine has also the characteristic that it gives very long tubes. By increasing the diameter of these somewhat, there will be no objection to their use, and a large amount of heating surface will be obtained, which means corresponding steam-generating capacity. The driving-wheels, it will be seen, are placed as near together as their flanges will permit—which gives short coupling-rods and less liability of breaking, which is a constant source of terror to some of us when we are riding on locomotives. The rods, too, it will be seen, instead of being below the cab, as in orginary engines, where they are the most dangerous, are in front, where they will be less liable to injure the occupants of the cab in case they or the crank-pins are broken. The feature in the engine to which there may be some demurral is the single-axle leading truck. There is still considerable doubt in the minds of many locomotive superintendents and master mechanics with reference to the safety of such trucks at high rates of speed. The process of reasoning which leads to this doubt seems to be that a two-axle or four-wheeled leading truck has been proved by long experience to be safe, and the inference is then drawn that if there is only one axle, there will be only half the safety. It would lead us too far now to examine the premises and the deduction which leads to this conclusion. Mr. Rhodes, however, after years of experience with mogul engines on his road in fast-express service, has ordered the engine which is illustrated in this number. He is a cautious man and generally sound in his conclusions, and has apparently acted with the approval of his superiors. Then, too, there is the fact that there are hundreds or thousands of mogul and consolidation locomotives employed in freight service, in which they often run at high rates of speed, and we have never heard it even hinted that they were not as safe in that service as 10-wheeled or decapod engines. It has been argued, and very plausibly too, that if a single-axle truck is properly constructed, it is *safer* than one with four wheels, and if the reported derailments of 10-wheeled express engines is confirmed, it adds plausibility to that conclusion. Anyway, the railroad public will be interested in learning the results of Mr. Rhodes's experience with his new engines.

Again our subject has extended beyond our limits and may be taken up again in the future.

THE MOST ADVANTAGEOUS DIMENSIONS FOR LOCOMOTIVE EXHAUST-PIPES AND SMOKE-STACKS.*

By Inspector Troske.

(*Continued from page* 543.)

II. THE HANOVER EXPERIMENTS (1892–94).

These experiments were suggested by the fact that a newly constructed high-speed locomotive was an exceedingly poor steamer, and that the usual remedies made only a very slight improvement. In order to ascertain the reason for this phenomenon, Herr von Borries, the Superintendent of Motive Power of the State Railways, decided to make a special investigation with different shapes of smoke-stacks, and had made for that purpose the apparatus illustrated by fig. 12. The author of this paper was intrusted with the execution of these investigations. They were commenced in the summer of 1892 at the main workshops of the railroad company, and continued on until the autumn of 1894.

The apparatus used is shown in fig. 12. It consists essentially of a lower steam chamber and an upper air chamber. The steam pipe with a diameter of 6.3 in. passed air-tight through the plate separating the two chambers and carried the nozzle at its upper end, this piece having an opening ranging from 3.9 in. to 5.5 in. The stacks subjected to the investigation had a diameter of 17.7 in., and were placed over the circular opening cut in the top sheet of the air chamber. On the four sides there were four air valves of the same size. It was the original intention to investigate the effect of various positions of the nozzle relatively to the lower end of the stack, and to do this by raising or lowering the nozzle through the means afforded by the apparatus illustrated in fig. 12. But it developed that when the nozzle was in its lowest position, the air chamber itself acted as a sort of stack, and it became possible, with the stack removed, to obtain a vacuum equivalent to $\frac{1}{4}$ in. water pressure.

In order, therefore, to render exact work possible, and for which purpose it became necessary to place a cap over the mouth of the pipe leading from the boiler, the location had to be obtained by more convenient means. The distance of the nozzle in question could then be changed without actually altering the position of the nozzle itself by changing the position of the stack by putting welded rings in between its foot and the air chamber. These rings were welded out of $\frac{1}{4}$ in. plates and were of the form shown in fig. 13. There were 10 of these rings, starting with one 1.57 in. in height and increasing in height by 1.57 in. By setting several rings on top of one another the distance of the nozzle from the lower end of the stack could be increased up to 30 in. or more.

During the tests the joints between the rings were kept well smeared with a paste, so that they were kept air-tight. The four air valves were so adjusted for the admission of the outer air that their combined free area amounted to 14.65 in. × 5.51 in. = 80.72 sq. in. This latter had previously been determined on a standard passenger locomotive in the following manner: After loosening the slide valve and then fastening in another in such a way that the steam ports were closed, a mercury manometer was connected with the empty steam chest of the locomotive and then enough steam was admitted through the throttle valve, the depth of the fire being the same as that ordinarily carried on fast runs, to produce a vacuum of 3.94 in. of water in the smoke-box as indicated by the water column attached thereto. The corresponding readings of the mercury manometer that measured the steam pressure were noted, and this was repeated several times until a whole series of results was obtained, and then an average was taken. Then a blast nozzle of the same size as that used upon the locomotive was placed upon the apparatus, and steam admitted until the mercury manometer indicated the average pressure that had been obtained by the previous experiments, when the air valves were so adjusted, the same amount of opening being left in each, that the vacuum indicated by the water column amounted to 3.94 in. This was then made the basis of the experiments which were thus warranted to correspond closely to actual practice. As a matter of fact also, as we have already remarked, the different shapes of stacks that were investigated with the valves in these positions were frequently transferred afterward to locomotives under steam and made fast, where precisely the same results were obtained. In consequence of the uniformity of results, the slight difference which existed between the steam measurements in the steam-chest and the apparatus due to the greater freedom of steam flow in the latter seems to be a matter of no moment.

The position of the four air valves being thus ascertained, the experiments were then carried on, admitting cold air into the chamber, while, in the actual work of a locomotive, it is well known that the temperature of the hot gases coming from the fire-box range from 575° to 840° F. Afterward similar experiments upon a running locomotive showed that the difference between the same shaped current of steam as applied in the apparatus or upon the standing locomotive and the steam acting intermittently upon a fast-running locomotive is of no importance whatever as far as the action of the stack is concerned, and though this is not the case with slow-moving locomotives, it is in no way troublesome to make a transfer or application of the results obtained with the experimental apparatus. It has already been stated here that isolated experiments with the apparatus in no way serve to establish the formula for the laws of actual service, but that these can only be fixed by experiments with running locomotives.

The next thing to establish was, how smoke-stacks of different forms would act with respect to the creation of the draft. Here it is a matter of slight importance whether the values of the vacuum obtained are in exact correspondence with the values observed on running locomotives or not.

In all the experiments with the apparatus the aforesaid positions of the air valves were left unchanged, hence the sucking

* Paper read before the German Society of Mechanical Engineers.

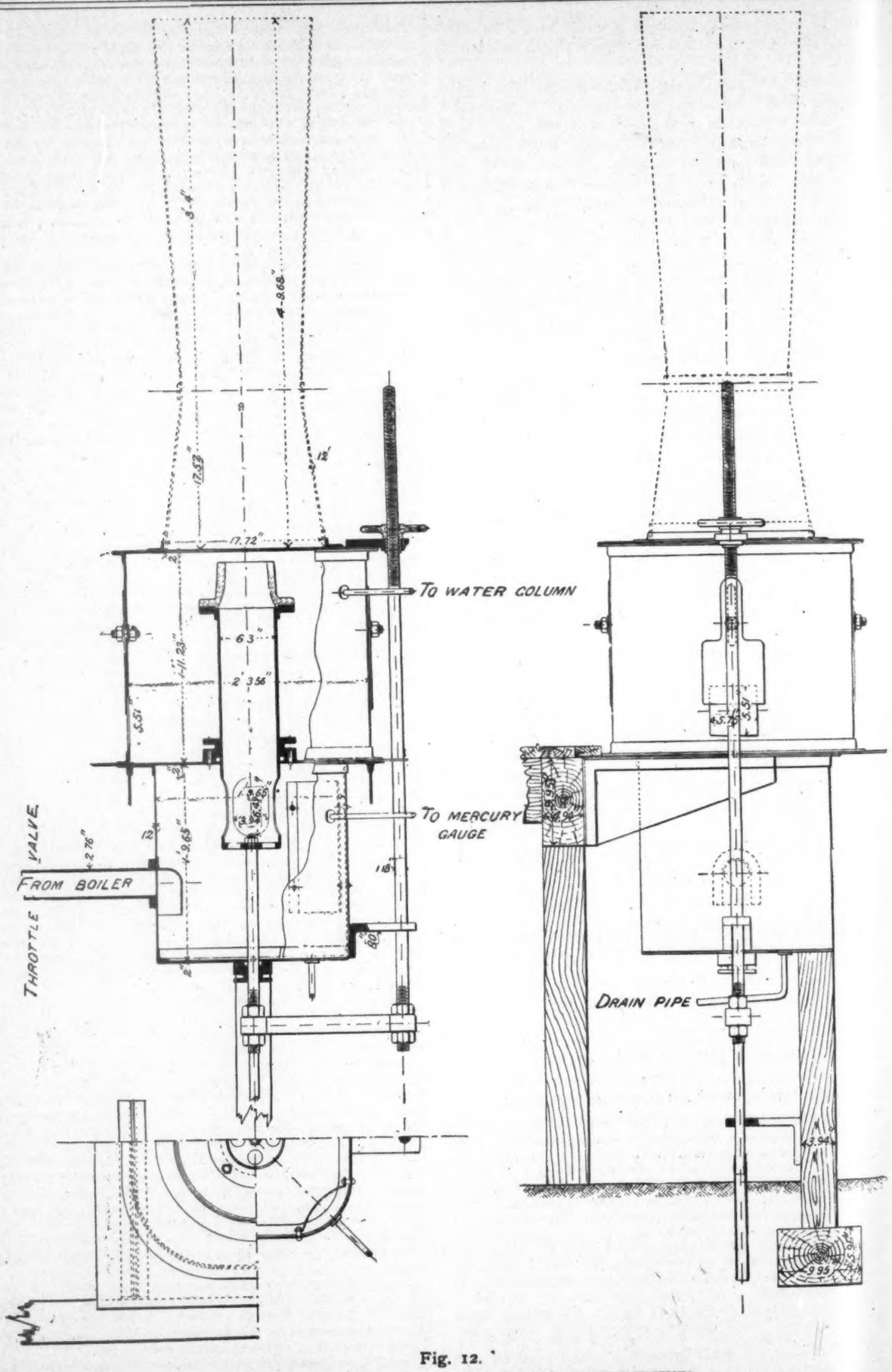


Fig. 12.

APPARATUS USED IN THE HANOVER SMOKE-STACK EXPERIMENTS.

action of the steam current could not be clearly shown for the different relationships, but only on locomotives of prescribed limitations. Moreover, though the experiments had already occupied so much time for the establishment of this basis, and though it was necessary for them to be carried on at spare intervals, it was very evident that they must be extended still

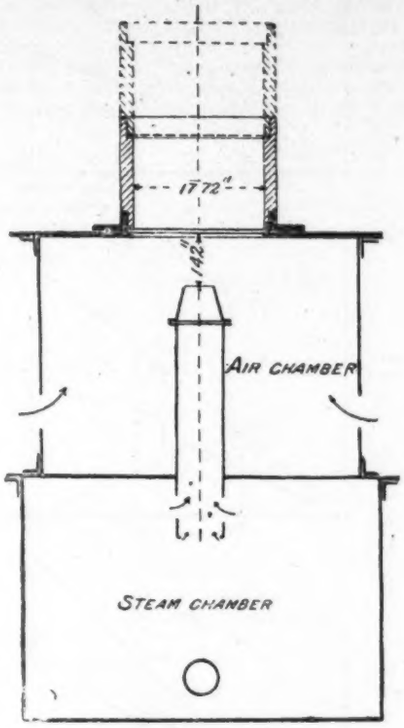


Fig. 13.

further in order to investigate the effects of varying the size of the air openings. These experiments were made with blast nozzles of five different diameters and 18 different smoke-stacks taken from locomotives of ordinary proportions. The dimensions and shapes were :

(*a*) Five different blast nozzles of 3.94 in., 4.33 in., 4.74 in., 5.12 in. and 5.51 in. in diameter as shown in fig. 14.

(*b*) Five cylindrical stacks of 13.78 in., 14.76 in., 15.75 in., 16.73 in. and 17.72 in. in diameter as shown in fig. 15.

(*c*) Conical-shaped stacks with converging top and bottom inclinations of $\frac{1}{12}$* and minimum diameters of 11.81 in., 12.8 in , 13.78 in., 14.76 in. and 15.75 in. as shown in fig. 16.

(*d*) Five conical stacks with an inclination of $\frac{1}{6}$ and the same minimum diameter as shown in fig. 17.

(*e*) Three funnel-shaped stacks (without a waist), of which one had an inclination of $\frac{1}{6}$ and a minimum diameter of 13.78 in., and two having inclinations of $\frac{1}{12}$ and minimum diameters of 13.78 in. and 15.75 in. as shown in fig. 18.

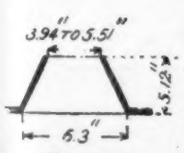


Fig. 14.

In the steam pipe leading from the boiler to the apparatus, which had a diameter of 2.76 in., a cut-off valve a throttle valve and a metallic manometer were placed. The throttle valve was fastened in a convenient position near to the apparatus where a wooden booth was set up, in which the measuring instruments were placed and from which the apparatus itself could be readily watched through a window. A reading of the instruments in the open, while the apparatus was in blast, would not have been possible, since the outrushing steam made an ear-bursting racket and the stack emitted the hot condensation of the steam, while showers of water prevailed all about.

Before an experiment began the apparatus, whose steam chamber was well protected by a thick layer of felt against cooling, was thoroughly warmed. The water of condensation of this chamber was carried off by a pipe that was left open during the experiment. By means of the throttle valve the pressure in the steam chamber was kept at the same height

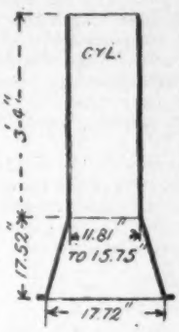


Fig. 15.

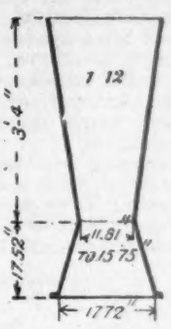


Fig. 16.

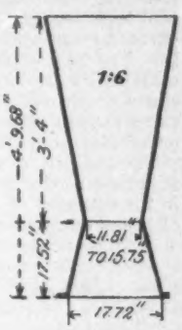


Fig. 17.

while the blast was in operation. The metallic gauge served to indicate the pressure existing in the boilers which was held within the limits of from 67 lbs. to 75 lbs. per square inch. In order that this great outpouring of steam might be maintained it was found necessary to force all three boilers of a neighboring battery up to their full power, though ordinarily they served to supply steam to a small steam engine and several steam hammers. With only two boilers in service, though the fires might be burning briskly, the steam pressure would gradually drop as much as .4 in. in the mercury column, which rendered accuracy in the results impossible ; though this same variation was not observable in the metallic gauge. This is offered in explanation of the contradictory results ob-

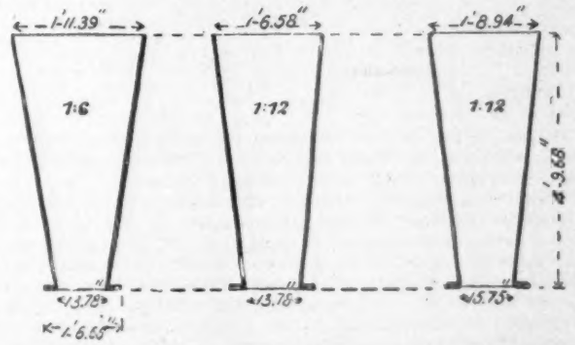


Fig. 18.

tained by the Prüssmann experiments. While with him the pressure of the very small amount of steam emitted was measured by a sensitive instrument, the small variations of boiler pressure were allowed to pass unheeded, though they had the greatest influence upon the amount of steam emitted ; in the Hanover experiments the great outflow of steam was controlled by a delicate instrument. In consequence of the latter condition and the making of a great number of observations, for in all more than thirty thousand readings were taken, the values obtained showed a very uniform course when plotted in the form of a diagram. The variation of the maximum and minimum values from the basis established by the general average was, in the majority of cases, about .04 in. at the most, and seldom ran as high as from .08 in: to .12 in. The observations repeated in different months gave the same ratios with the same stacks, and always the same vacuum was reproduced. The temperature of the air only had an influence upon the results in so far as that the readings taken during the colder months for each position of the blast-pipe fell from .12 in. to .2 in. lower than when the weather was warm, due to the fact that the current of steam clung more closely to the sides of the stack. This affects, then, only the boundary limits of the dropping ends of the curves, and consequently the position of the nozzle, which is not changed in practice, and is, therefore, of no importance in connection with the respective stacks.

We next took up the task of establishing the relationship existing between the pressure in the blast-pipe and the vacuum.

* By "inclination" the inclination of the two sides of the cone is meant; each side naturally has, therefore, but one half the above-stated inclination to the vertical. If the inclination of the stack is considered to be n, then one side of the cone will be $\frac{n}{2}$; if the length of the stack be considered to be equal to l, then the upper diameter of the stack will be—greater than the smallest diameter. For example, if we have a stack 3 ft. 6 in. long, with an inclination of $\frac{1}{12}$, we have an increase of diameter of $\frac{42}{12} = 3\frac{1}{2}$ in., or, with an inclination of $\frac{1}{6}$, an increase of $\frac{42}{6} = 7$ in., etc.

Already in his experiments with a locomotive under steam but stationary, Clark had obtained results sufficient to prove the proposition that the vacuum stands in a direct ratio to the blast-pipe pressure. This was investigated with the apparatus with stacks having the greatest variations of diameter and length and with all five of the blast nozzles, and was found to be in exact correspondence in every instance.

If we take the blast-pipe pressure as abscissas and the corresponding vacuums as ordinates, the end points of the latter will form straight lines. In figs. 19 to 23 these diagrams are given for the operation of a stack having a diameter of 13.78 in. The blast-pipe position for all 15 of the readings was the same, or 1 ft. 10 in. Equal abscissas correspond to equal steam pressures. If the latter were twice, four times, or five times as great, the vacuum would increase twofold, fourfold, or fivefold, as the case might be.

The amount of steam issuing forth increases as the diameter of the nozzle is made larger, about in the ratio of the square of the diameter of the nozzle. If we consider that the amount of steam issuing from a nozzle 4 in. in diameter to be equal to 1, it follows that, with the same steam pressure and a

Nozzle diameter	= 4 in.,	the steam delivered	= 1.00
"	"	= 4.4 in.,	"	"	"	= 1.21
"	"	= 4.8 in.,	"	"	"	= 1.44
"	"	= 5.2 in.,	"	"	"	= 1.69
"	"	= 5.6 in.,	"	"	"	= 1.96

Notwithstanding the fact that with a nozzle diameter of 5.6 in., nearly twice as much steam is delivered as would be through one only 4 in. in diameter, a casual comparison of these five diagrams shows that the vacuum rises in a far smaller ratio.

To make this still clearer, the following figures are brought together:

TABLE I.

Diameter of Stack.	Shape of Stack.	Increase in the vacuum with the nozzle located at 22 in., if the nozzle diameter is opened from 4 in. to 5.6 in.
13.78 in.	Cylindrical...	From 4.08 to 4.6 in. = .52 in. = 12.7 per ct.
	Conical $\frac{1}{12}$....	" 3.96 " 5.14 in. = 1.18 in. = 30.7 "
	Conical $\frac{1}{6}$.....	" 3.4 " 4.84 in. = 1.44 in. = 42.3 "
15.75 in.	Cylindrical...	" 3.58 " 4.42 in. = .84 in. = 23.4 "
	Conical $\frac{1}{12}$....	" 3.08 " 4.36 in. = 1.28 in. = 41.5 "
	Conical $\frac{1}{6}$.....	" 4.88 " 3.78 in. = 1.1 in. = 52.4 "

Hence, if the outflow of steam increases by about 100 per cent., the vacuum (under this ratio) will increase about 52 per cent., the shape of the stack remaining the same.

From these five diagrammatic representations we can readily see, without any further demonstration, how a cylindrical stack having a diameter of 13.78 in. falls off in its action with the same amount of steam as compared with the conical stack. With a nozzle diameter of 4 in. the cylindrical form seems to be the best when taken in connection with the height of the vacuum; at a diameter of 4.4 in. it nearly coincides with the conical form having an inclination of $\frac{1}{12}$; with a further opening of the blast nozzle it drops down below the last-named form, until at a diameter of 5.2 in. for the nozzle it has fallen even below the stack having an inclination of $\frac{1}{6}$.

In other respects the diagrams show that the action of the cylindrical stacks is very much better than that of the conical if we take stacks having a larger diameter than 13.78 in. It so happens, then, that under the same ratios as shown in figs. 19 to 23, that with stacks having a diameter of 14.76 in., the cylindrical stack first coincides with the conical stack having an inclination of $\frac{1}{12}$ when the nozzle has a diameter of 5.06 in. With a diameter of 15.75 in., as well as with all five diameters of nozzle, the cylindrical form is superior to the conical (the nozzle position being 1 ft. 10 in.) as is shown by figs. 24 to 28.

We next have to show the reason why we believe, from the results obtained from the experimental apparatus, that a cylindrical stack 13.78 in. in diameter and 4 ft. 9.68 in. high is too small to be used with a nozzle 4.33 in. in diameter, just as a stack of 14.76 in. in diameter is too small for a nozzle having a diameter of 5.06 in. or more. And we are inevitably led to the further conclusion that the cylindrical stack, as being also superior at the smallest cross-section, must be preferred to the conical stack if we expect to maintain the same vacuum with the two forms under the same conditions. Likewise the conical stack should be given different inclinations, and the narrow inclination of $\frac{1}{12}$ be increased to $\frac{1}{6}$, as shown latter in Section X.

Finally, we can state, as a well-defined conclusion, that the blast-pipe pressure has no influence upon the form of the stack, a conclusion that Prüssmann has already announced as the re-

Fig. 19.

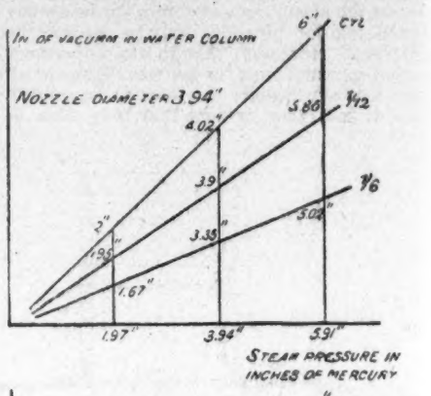


Fig. 20.

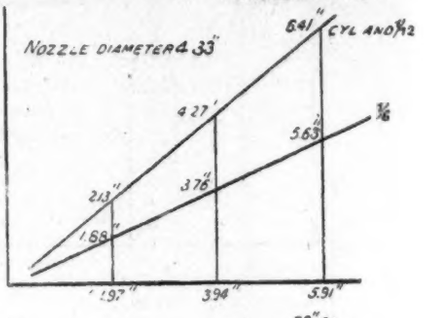


Fig. 21.

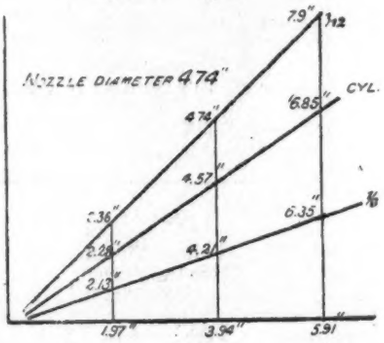


Fig. 22.

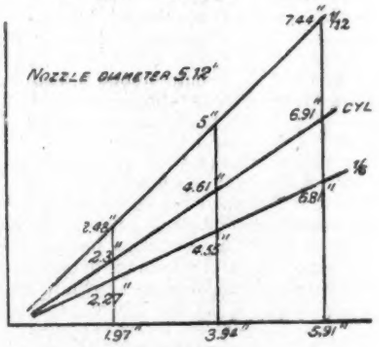
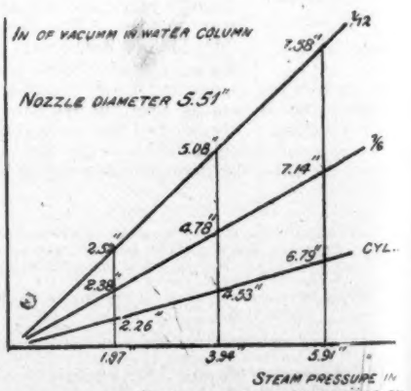


Fig. 23.

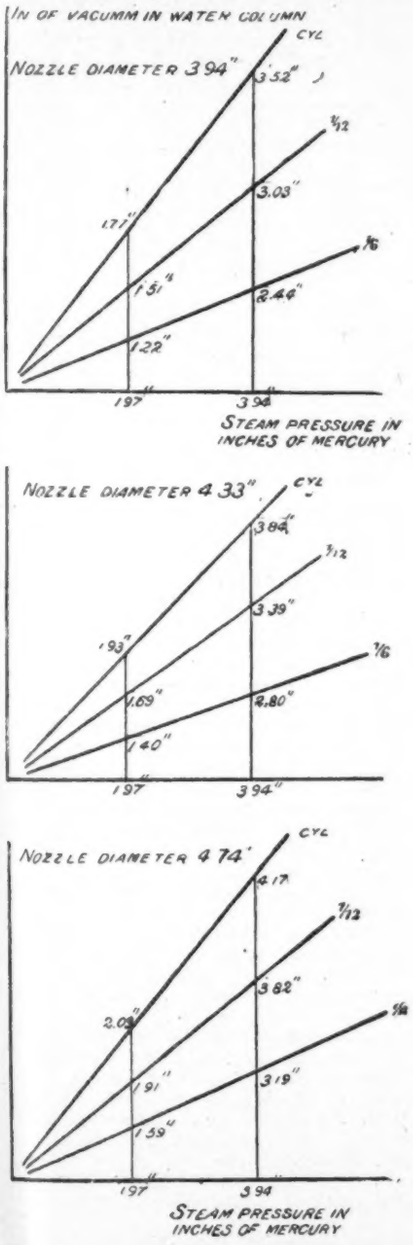


sult of his experiments. Figs. 19 to 23 and 24 to 28 show this to be the case without the necessity of any further references; for the trend of the vacuum lines for the three different shapes of stacks maintains the same relationship to each other for all blast-pipe pressures, the nozzle diameters remaining the same. This position permits one to choose any steam pressure that may be desired for the experiments, even though it may not exactly correspond with the blast-pipe pressures as they exist in the locomotives. The Hanover experiments were now conducted with a steam pressure of 3.94 in. of the mercury column, a value which, as was afterward established, corresponded almost exactly with that existing on the standard passenger locomotives when running at a speed of from 34 to 37 miles per hour, a cut-off at .2 stroke, and exhausting through a nozzle of 4.74 in. in diameter. All of the experiments with the 18 stacks, of which 15 were in four different lengths, were made with this steam pressure, the openings into the air chamber remaining the same, and all other conditions being unchanged.

Each stack was tested with five different diameters of nozzle openings. In all there were 320 different combinations of stack and nozzle relations tested. In each of these relations there were at least 10 different positions of the nozzle employed and as many curve points marked with each six readings for the purpose of reaching a definite conclusion.

(TO BE CONTINUED.)

Figs. 24 to 26.



Figs. 27 and 28.

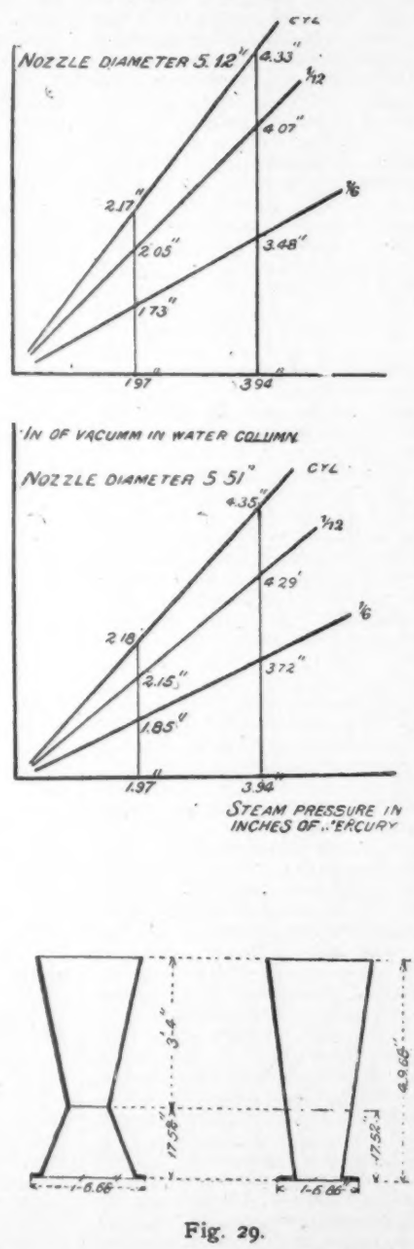


Fig. 29.

SOME DIFFICULTIES OF ELECTRICAL RAILROADING.

IT goes without saying that the application of electricity to the propulsion of street cars has made most marvellous advances during the past nine years, when it received its first really successful application. But if we can believe the testimony of the experts who have spoken upon the subject, all is not smooth running, and the lot of the superintendent of repairs is not a happy one. A certain king, we are told, once made an attempt to run a number of clocks in exact unison, and made such a failure of it that no one has since had the courage to so much as make the attempt until the electricians started in to do practically the same thing by putting two motors upon a single car and hoping, though they knew that there was no ground for expecting a realization of their hopes, that all would would work well and satisfactorily. This and the difficulty existing in the present use of gears for transmitting the power from the armature shaft to the axle are the two great bugbears of electric traction. That there should be a difficulty with the latter is not at all surprising when we consider the location in which they are placed and the usual condition of that location, besmeared and bespattered as it is with mud and dirt.

The first cars were driven by sprocket wheels and chains with the motors on the platform, but this system was soon abandoned for the method now used, and which has all along been considered as unsatisfactory. As long ago as in 1890 Dr. Louis Bell, in speaking on the subject, said: "At present nearly all electric cars are operated by plain-toothed gearing. In the existence of this lies one of the difficulties that must be overcome in the future. To-day the grinding gear wheels underneath the car constitute the most serious mechanical difficulty in electric railroading, and it should be the object of inventors to dispense with them if possible. They rattle and grind and squeak, teeth break, bearings get hot, and there is no man who is practically acquainted with their manifold failings but heartily wishes them out of the way, and few people have any idea of the mine of power that these grinding cog-wheels waste. Most of our present electric cars have two motors, each with its appropriate set of gears, and it is an unfortunate fact that these two do not always pull together in the harmony that might be desired. There is a constant tendency for one of them to do more than its share of the work,

and aside from this, the two sets of gears consume an outrageous amount of power, which, it should be remembered, does not go into useful work, but simply tends to heat and wear out the running parts. It is pretty clear that there is a disadvantage in the use of two motors, except in so far as it is convenient to drive both axles for ease of ascending grades, and it is no less evident that a considerable power can easily be lost in gearings. We may hope in the near future to have a system of motor cars in which considerably less power will be required than at present, and this by the simple but somewhat difficult process of simplifying the running gear."

Again, two years later, in a discussion on the subject before the American Institute of Electrical Engineers, it was stated that the gears used waste "30 per cent. besides by grinding themselves to dust, and how much the losses are in high-speed gearing nobody knows." At the same time, a case was cited of an English system where with very carefully cut zig-zag gears the loss amounted to as much as 40 per cent., and it was added that "street-car gears must be very wasteful, not only because of the rough usage they are exposed to when going through rain and dirt and over dusty roads, but from the fact that the transmission of power by gearing is at the best only when the height of the gear teeth is negligently small compared with the radius of the gear. But the high-speed gearing pinion must necessarily be small, and then the height of the teeth is very perceptible compared with its radius. In this case the gearing does not transmit with a fixed but with a varying ratio. The teeth touch each other first with their heads, slide over each other and come out of impact when touching each other with their feet. That means that the ratio of transmission for each tooth which passes another varies between the ratio of the maximum and the minimum radii of contact.

"Thus, suppose the pinion has 16 teeth, the motor revolves at the rate of 1,200 revolutions per minute. Then 10,200 times per minute the leverage of transmission goes up and down. This is what causes the rattling and hissing noise of high-speed gearing and their rapid destruction. That the loss of energy in the gearing is considerable we can see without any tests if we consider in what very quick time steel and phosphor bronze pinions are ground to dust and rawhide gears torn to fibres. For the law of the conservation of energy teaches us that where a display of energy takes place, a corresponding consumption of energy exists, and if such tremendous energy is set free as to grind steel and bronze to dust and to chop rawhide pinions rapidly into fibres, the consumption of energy must be correspondingly large and the only source of energy is the motor."

A third difficulty of a purely mechanical nature is to be found in the method of supporting the motor upon the axle. The tail is usually carried by some elastic support, but the main body and weight of the motor is carried by bearings resting directly upon the axle, and consequently liable to all of the thumping and pounding of the wheel upon the rail. This naturally works to the disadvantage of both the rolling stock and permanent way; the constant jolting disturbs the action of the motor, and the heavy, uncushioned pound of the latter upon the joints has compelled street railway companies to resort to the use of a rail that has a vertical stiffness fully up to that demanded by heavy-traffic steam lines, though the weight of load per wheel is insignificant as compared with that to be found on locomotives, thus showing that the so-called locomotive hammer-blow is not the worst of all evils in the maintenance of proper track alignment. An attempt has therefore been made to mitigate this trouble by remodelling the design of the motor, and one has been brought out which is so suspended that, for a machine of 25 H.P., only about one-third of its weight has been thrown upon the axle, and it rests upon a spring like cushion which obviates the chance of accident to the axle and lessens the pounding upon the track.

When this motor was first presented it was stated that the modification embodied in it would have a great influence in doing away "with the tremendous hammer blows upon the track. If the difference in dollars and cents per year expended in road repairs between a system having 2,500 lbs. over each car axle and one having 500 lbs. could be determined it would be a startling exhibit. Railway managers are aware of a constant need of heavier rails, and they can only account for it by concluding that the increase of car service, coupled with the additional weight on the axle incident to electric railway traffic, has never been sufficiently provided for by electrical engineers. In all double-motor equipment the weight on each axle is very large. So it will be seen that this modification in the system of motor suspension is of significance in electric railway practice. The greater part of the dead weight is more evenly distributed to the axle bearing and that part of the truck which can better stand the strain. This means greater economy in track maintenance and a decrease in the possibility of accident to the axles."

Then we come to the car wheels. That the wheels under street cars should wear more rapidly per mile run than those upon steam lines is evident from the fact that they run with the brakes applied for a great portion of the time, and that these brakes are, from the very conditions of the service, well supplied with an abrasive in the shape of sand. To pass from the horse car to the one driven by electricity, we find the conditions still worse, for when the brakes are not applied the wheel is acting as a driving-wheel upon a track that is always sanded. "These wheels are constantly slipping, even upon straight tracks. Take the ordinary car with two motors. It will have a wheel base of 6 ft. or 6 ft. 6 in., with a 20-ft. body. When in operation, and especially if loaded at the two ends, the overhanging weight causes teetering or galloping. This motion alternately imposes extra weight on one wheel, while the load upon the other is diminished. As the load is lightened the traction of the wheel diminishes, and since the motive power remains constant, there is a certain amount of slipping, while the other pair of wheels do more than their share in driving the car. The next instant the motion reverses the conditions, and the other wheel slips. This slipping, due to teetering, seems to be almost constant upon some roads. In addition to this, the wheels frequently slip without moving the car, and this slipping is sufficient to account for a large proportion of the unusual wear of the driving-wheels under trolley cars."

This rapid wearing of the wheels is a serious matter when viewed from the standpoint of repairs, aside from the actual cost of the new wheel, for "no car wheel can be replaced to any advantage without taking out the truck, pressing off the wheel, pressing another on, replacing it in the truck, and replacing the truck under the car. The expense of replacing one wheel has been variously estimated at from $2, in steam railroad service, up to $10 in street railroad service, where the motor has also to be removed and the gear taken from the axle."

Such are some of the mechanical woes of the electrical railroad man. To quote again from Dr. Louis Bell: "It is evident enough that the gain due to the abolition of gearing in the gearless motor is sufficient to compensate for no small loss of electrical efficiency," and he then proceeds to demonstrate that there would be a great saving effected by the use of a single motor and the abolition of one set of gears, and this position is supported by "many engineers who object on theoretical grounds to the use of two motors under any conditions, on account of the tendency of any two armatures to work out of unison if there happens to be any disparity between them, either in the armatures themselves or in the strength of the fields in which they revolve. It is very evident that if the two motors fail to work in the most perfect unison, the resultant effect will be less than it should be; that the perfect unison of action between two separare motors so essential to the highest efficiency of operation is practically unattainable, and is admitted by all."

Extraordinary differences in efficiency have been found by various experimenters between the use of two motors and one, and that the former "diminishes the efficiency to an amount as high as 60 per cent. or more"—a difference which can be partially explained by "slipping and skidding frequently repeated and which are not directly perceived. But an aggravating cause lies in the difference in magnetic fields. Thus, when slipping occurs, one or the other of the motors increases its torque in order to overcome the total resistance which it has to encounter independently of the other; while, when either motor is subjected, by slipping, to a resistance less than the normal, the other motor is affected by the feeble resistance, and tend to stop in unison with the resistance which they encounter themselves, permitting the first motor to turn alone, whether at rest or at any speed. With the motors disposed of in parallel, cases of partial slipping are not excluded."

These are some of the mechanical difficulties that are and have been attracting the attention of street railway men, and it is difficult to see just how a combination can be designed that will obviate all of the troubles that exist. The gearless motor does away with the gearing, but it does not seem to have made much headway in general and extensive application, probably from the fact that it is better adapted for long-distance and interurban service than for the traffic of a town, with the frequent stops and constant changes of speed. And the gearless motor does not lessen the difficulty of the weight on the axle, but rather aggravates it, besides adding to the cost

of the removal of wheels. That the problem will be so solved that all of the difficulties will be removed does not appear to be the promise of the immediate future, but that the evils complained of will be at least mitigated seems to be in the line of general development, and should be the natural result of the efforts that are being made.

THE OCCUPATION OF AN ENGINEER.

MR. ARCHIBALD DENNY, in a presidential address recently delivered before the Institution of Junior Engineers, dwelt upon the occupation of the engineer, and especially upon the education that should be given him in order to fit him for his work. He prefaced his remarks by stating that what he might have to say would have especial reference to ship-building and marine engineering, but that it would also find an application to other branches of engineering. He deprecated the extensive courses in Latin and Greek that are given, and then entered upon his subject by a reference to mathematics.

"Mathematics—at least the elements of it—and the elements of mechanics, chemistry, and physics, should be thoroughly mastered, so that at the age of sixteen, or at the latest seventeen, provided the boy's physique is fairly developed, his apprenticeship might begin. Now, I think it must be beyond dispute that given a lad who intends to tread the higher walks of the profession, and not merely to begin and end as a workman, it is not necessary that he should spend five years at the bench to learn his trade, to gain sufficient expertness in handling the tools and to study practically the qualities and properties of materials; hence my ideal course is as follows: Begin by spending alternately six months—the six summer months—at the bench, and then six months—the winter months—at a first-class technical school or college. As the college or technical school course is generally one of three years, at the end of this time, or in four years at most, the youth should have had enough of the bench and should be quite ready for the drawing-office; the shorter period should suffice in the ship-building-yard and the longer period for the marine engineer. If a ship-builder, then he must remain in the drawing-office or fight his way up through manager to principal as his ambition, opportunity and ability lead him. If a marine engineer, then after a year or two in the drawing-office he should certainly proceed to sea, and if possible get his chief and extra chief's certificate, and thereafter work his way upward on shore.

"This is my ideal course roughly sketched, and one which is being followed out in our yard and engine works whenever possible. Of course every man cannot afford, or has not the opportunity of following out this course; then all that can be done is to study in the evening—not to too late an hour—and take evening classes. Some of our most brilliant men have succeeded in this way alone, but who can say what they would have been if they had had the advantage of such a course as I have sketched out? Endeavor to be apprenticed, if possible, to a firm who do not take premium apprentices. The policy of taking premium apprentices is, in my opinion, a mistaken one, both for the employer and the apprentice. The foremen in the works, and heads of departments generally, have the feeling that premium apprentices must be more leniently treated than the ordinary apprentice, and this feeling is sometimes so strong that we need not wonder at it reacting upon the premium apprentice, and inducing a state of indifference in those who do not start with strong moral fibre. If there are many premium apprentices their effect on discipline in the works must be detrimental, and even supposing that a few out of the many have a higher ideal than their fellows, it is difficult for them to strike out a different course of action from that of the majority. Not having had personal experience of premium apprentices, my views upon this subject may be rather strong, and I know that many young men find it impossible to learn their profession by any other means, but I think it would be an improvement if firms who do take premium apprentices made it a rule that these apprentices were to be treated in exactly the same way as ordinary apprentices, paid the same wages, expected to fulfil the same conditions, and to be advanced only as a reward of real merit. In that case the premium apprentice would either, as the result of lack of application, simply finish his time an ordinary workman; or, as it should be, his superior initial education, with equal application, would ensure his being advanced more rapidly than those who started with fewer advantages, through the drawing-office to a position of trust. I have great sympathy with premium apprentices. I think their surroundings render it difficult for them to do their duty, and the spur of necessity is lacking in many cases, but this is all the more reason why I should point out the dangers, and impress the necessity for facing the difficulties and dangers of the position with a strong determination to overcome them.

"During apprenticeship a lad will doubtless have many opportunities of bringing himself prominently, by good work and conduct, to the notice of his employer and foreman, but while he should seize every favorable opportunity of doing so, he should avoid making himself objectionable by pushing himself forward in season and out of season. To do so will only disgust his superiors and gain him the dislike of his fellow-workmen. Favorable opportunities of bringing himself before the notice of his employer will occur most frequently when in the drawing-office, and the best opportunity is when he is given a piece of investigation work involving probably the carrying out of experiments. If any of you are ever in this position you should be most careful in carrying out the experiments; only draw conclusions after these have been confirmed by a frequent repetition of experiments. Some men have a natural bent toward experimenting; it seems natural to them to tabulate an experiment in the best possible way, and their work at completion is so thoroughly well digested that the results are easily assimilated by the principal, and hearty commendation follows. Under these circumstances it is certain that this man's services will be frequently requisitioned; he is thus brought in close contact with the principal, and his rapid advancement ensured. Such cases have often occurred in my own experience. The careful and accurate man appeals to one immediately, and if this is combined with rapidity in carrying out work, his services are highly prized.

"Another point I want to notice, and one which has been already touched upon by a recent president, is the question of loyalty to your employers. Undoubtedly this is one of your first duties, and a duty that you owe not only to your employer, but also to yourself, because an act of disloyalty to your employer is really an act of degradation to yourself, even if not found out, a constant repetition of which will so undermine your moral character that you become an object of contempt to yourself, which appears to me a more serious thing than being an object of contempt to your fellow-men; indeed, the latter only becomes possible long after the former is an accomplished fact. I know it is the practice of many draftsmen to appropriate information from the drawing-office in which they are employed, to copy plans and tabulated data. Now this, in my opinion, is immoral, besides which I consider it, so far at least as plans are concerned, and also as far as a good deal of tabulated data is concerned, a great waste of time. I have a friend who was once a draftsman, and he has told me that there are now in his possession many plans cribbed in this way, and that he was incited to do this by the needless prohibition and difficulties placed in his way by a suspicious employer. As a matter of fact, he did not gain any advantage from this, as from the day he cribbed them till now they have never been looked at.

"Progress is so rapid nowadays that the mere copyist will always be left behind, and if a man has not sufficient ability from his past experience to scheme out improvements, he will soon be left in the rear along with his cribbed information. May I read you a few sentences from the general order book in force in our yard? 'As there is growing in our office a large amount of special and organized information procured and organized at considerable expense by us, it must be clearly understood by every member of our staff that we consider this information private, and to be used only in our service. Any member of our staff found copying or removing any of this special organized information will be considered to have acted against honor, and will, on our coming to know of his action, be immediately, and without further warning, expelled from our offices. To such a person we will decline to give either reference or character. We consider that the opportunities afforded to the members of our staff in their ordinary work and for private study by our library are sufficient to enable them to acquire a knowledge of all methods of working by means of which, should they leave our service for that of some other firm, or to start on their own account, they can collect and organize information for their employers or for themselves. There is, therefore, no excuse for their acting against honor in the way we have now forbidden.'

"I think these sentences put the matter very clearly and fairly, and may assist young men in deciding upon their course of action. I would, therefore, counsel you to gain experience and store it in your brain, and make notes only of such general principles as you find in use or discover for yourselves, and do not run the risk of lowering yourself in your own estimation by taking that which is another's. You should be absolutely loyal to your employer while with him, identify yourself with

him in every way and make his interests yours, and when you leave one employer to go to another you should carefully consider how much special information you shall impart to your new employer, more especially if he happens to be a rival to your last.

"I would like to give another warning to young men. Cases have come to my knowledge where foreign competitors have by specious promises induced able young men to leave the employ of a specialist in this country, so that he might assist a foreign rival in establishing a similar business abroad. The object was perfectly apparent and was recognized by both parties—I mean both the foreigner and his dupe. A much larger salary was fixed than he was in receipt of previously, with an agreement for a certain term of years. Everything went smoothly until the information possessed by the young man was transferred to his new employer, and then the position became uncomfortable—in fact, so uncomfortable that long before the expiry of the agreed-upon term of years the young man was glad to leave and return to England, sadder and wiser.

"A last hint, and one which I have often found it necessary to give: Hold your tongue about what goes on inside the drawing-office, especially in regard to proposed work. It frequently happens that from the lack of this precaution, information passing from one drawing-office to another induces competition of an unfair nature which otherwise might have been avoided. Now, if you become chief draftsman you will for the first time have control of a number of other men, and you have added to you a serious responsibility in the management of them. Some men are by nature fitted to rule others; other men, good men no doubt, are by nature quite unfitted to do so, but much can be done to correct this latter imperfection. Constant remembrance of the golden rule, "Do as you would be done by," will help; treat those under you with kindness and justice, but at the same time you must be firm in enforcing rigid discipline. One fault which principals find it difficult to excuse, and which should always be avoided, is shunting the responsibility for mistakes on to a subordinate with the remark: 'I am very sorry, but Mr. So-and-So made the mistake.' This is most disagreeable, and points to a lack of manliness.

"A chief draftsman should take the entire responsibility of the work passing through the office, should take the blame of any mistake upon himself, and not endeavor to shunt any blame on to the shoulders of a subordinate. This should not prevent him at the same time from passing on the remarks of the principal, with a few additional ones of his own, in order that the same mistake may not occur again. Be punctual yourself and insist upon absolute punctuality in your subordinates. When several pieces of work appear equally important, and it is a question in your mind which to tackle first in the morning, choose the one you like least, and this once finished, the others will go down before you like corn to the scythe of the reaper; this is a golden rule imparted to me by my late brother, which by long experience I have found invaluable. You will find it a useful thing to keep an agenda or question book and go over it every day yourself, also if possible with your superior, noting his instructions. I think I should refer you at this point to a paper I read early this year before the Institution of Engineers and Ship-builders in Scotland, entitled the 'Drawing-office,' in which you will find, I believe, many useful hints as to organization, should you be called to the position of chief draftsman.

"Suppose, now, that you go a step higher and become manager, your responsibility is further increased, and you have now a new set of conditions to deal with. You should still more closely, if possible, link up your principals' interests with your own. The most serious part of your duty will be in maintaining discipline in the works. Man in general is a most complicated machine to deal with, and the workingman is perhaps the most complicated machine of the human species. In most machines, given a certain set of conditions, you can predict what will happen when the machine works, but often with the human machine exactly the reverse happens to what you might have expected. No minute rules can be, therefore, laid down for the management of men, but you will go a long way toward success if, following out the treatment of your men in the drawing-office, you deal with the men in the works in a firm but pleasant way. Be definite in the orders you give, and see that they are promptly and cheerfully carried out. Do not be unreasonable in your demands, and in all your dealings with the men and the arrangements you make with them, be perfectly honest and straightforward, trying if possible to put yourself in their place. If you have profited by your time at the bench, you will not find this very hard to do. Where necessary, make written notes of any arrangements as to wages, etc., immediately they are made, read them to the men, sign them yourself, and get them to countersign. Leave nothing ambiguous, nothing doubtful, and if possible deal directly with the men, and not with paid agents. You will find under these circumstances that with few exceptions the workingman is to be trusted and admired. You must not suppose from what I have said about paid agents that I object to Trades Unions, but I do object to paid agents interfering at every moment, and with every petty question between master and man. I think that the men are quite able to discuss any detail at a meeting with the manager or master, and that an amicable arrangement is more likely to result from this course than when an outsider is called in to discuss the matter, who has no real personal interest in the works.

"You will find it advantageous to spend an hour in the factory before breakfast. An hour thus spent is worth two later in the day, when it may be difficult to spare the time, pressed as you probably will be by other business, visitors, outside contractors, etc., besides which it allows the foremen to get their instructions for the day, and you have a clearer mind, and are undisturbed by the thought that you are wanted elsewhere. Another reason is that any slackness and waste of time on the foremen's or workmen's part is more likely to occur then than later in the day. Never force a man upon an unwilling foreman. You are often asked, mostly by soft-hearted clergymen, to give some poor weak soul a chance. As a rule, resist the appeal; there are and should be exceptions. But as a rule you will find it labor wasted. Remember the cripples. There are always a dozen or so of easy berths which should be kept either for the old or maimed, and, even if an able-bodied man gets employment in them, he should at once be removed if a cripple comes along. Of course I mean your own cripples; don't saddle yourself with other people's.

"An important question is the amount of interference you should allow yourself between foremen and workmen. Theoretically there should be none, practically it should be the minimum possible, otherwise your time will be entirely taken up in perpetually listening to two sides of stupid differences. At the same time you should reserve the absolute power of dismissal or employment, always, however, through the foreman, and further, your ear should be open to any well-founded complaint of injustice on the part of a foreman to a man. If you are careful in the first two or three cases to dispense absolute justice, you will be little troubled later, because both foremen and men will be watchful of what they do. Keep in view the possibility of nepotism in foremen, and you must be quick to stamp it out; it is most detrimental to discipline. In both these cases you will observe that to manage properly you must have an intimate knowledge of your men. In a case of any man doing a piece of meritorious work, you will find it a good thing to take personal notice of it; it is the right thing to do, and encourages the man. I have often seen cases where a kind word, some tobacco or a few cigars given on the spur of the moment, have been more appreciated than a money gift.

"You should take a personal interest in your apprentices, they are your future workmen, encourage them to continue their education in every way possible at evening classes; the better educated they are, and the more they are on a par with yourself, the more easy it is to get on with men.

"The next step in the ladder is when you become a principal or partner in a business, and now your burden is greatly increased. You no longer work, in all likelihood, for a salary, and you have therefore all the care and anxiety of making sure of your livelihood. But you have a high duty also to all those under you, and you should take an interest in them not only in the works, but outside of the works; not a patronizing interest, not a mere subscribing to their schemes, their football clubs, cricket clubs, etc., but take an active interest in their pleasures and in their sorrows, and in doing so you will not only lighten their cares, but you will also have your own cares lightened by their sympathy and human interest. Above all, avoid trying ill-considered socialistic experiments, which to be successful assume that workingmen are all angels; they are no more angels than you are, and such schemes are failures before they are tried; only benefit schemes on a sound financial and co-operative principle will succeed—I mean those which are just to both parties.

"I may mention two schemes which have proved successful in my own experience—viz., an accident fund, managed by a committee, appointed in equal numbers by both master and men, and to the funds of which equal contributions are made; and also an awards scheme, by which men are rewarded who either invent new methods or machines, or introduce any scheme by which production is cheapened.

"Should you unfortunately after all your efforts be confronted by a prospective strike, consider well the situation, make up your mind what, under the worst circumstances, you would be induced to accede to, and having done so, say a final

yea or nay. Do not be readily induced to begin a strike and then give in; vacillation of this kind has been the leading cause of strikes. If the men realize that when you say yes you mean yes, and no, no, strikes will not readily occur, and you will notice that the modern tactics are all tending toward avoiding strikes, if at all possible. The men always lose by them and also the masters, for even if success crown the efforts of either party, the gain is never sufficient to make up for the individual loss.

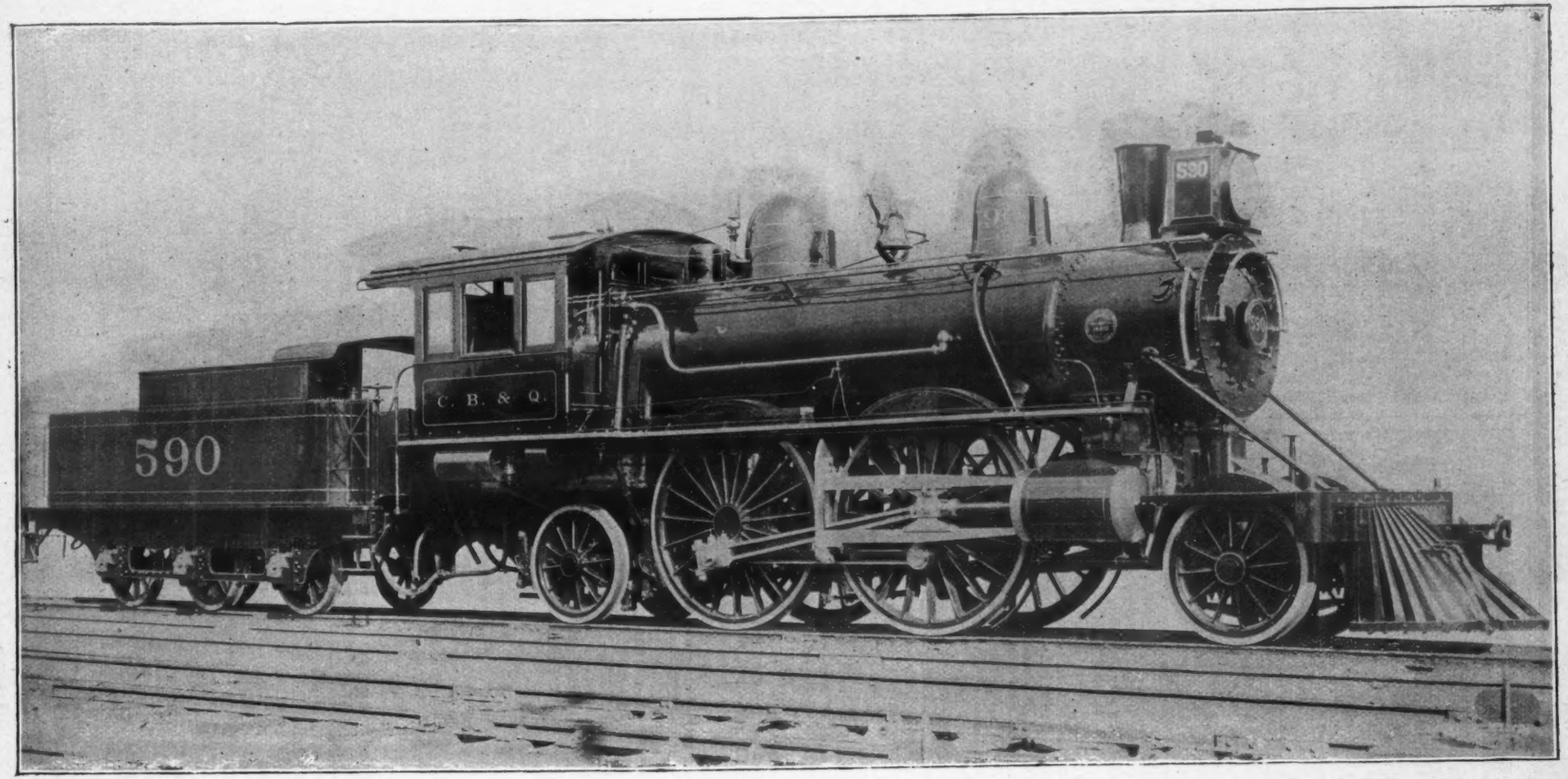
"I happened to read recently a paper by an American—Mr. Fred. W. Taylor—read before the American Society of Mechanical Engineers. In his paper there are a few sentences which so thoroughly express my own views, that I am sure Mr. Taylor will not object to my extracting them for you. He says, 'No system of management, however good, should be applied in a wooden way. The proper personal relations should always be maintained between the employers and men, and even the prejudices of the workmen should be considered in dealing with them. The employer who goes through his works with his kid gloves on, and is never known to dirty his hands or clothes, and who either talks to his men in a condescending or patronizing way, or else not at all, has no chance whatever of ascertaining their real thoughts or feelings. . . . Above all it is desirable that men should be talked to on their own level by those who are over them. Each man should be encouraged to discuss any trouble which he may have, either in the works or outside, with those over him. Men would far rather even be blamed by their bosses, especially if the 'tearing out' has a touch of human nature and feeling in it, than to be passed day by day without a word, and with no more notice than if they were part of the machinery. . . . The opportunity which each man should have of airing his mind freely, and having it out with his employers, is a safety valve; and if the superintendents are reasonable men, and listen to and treat with respect what their men have to say, there is absolutely no reason for labor unions and strikes. . . . It is not the large charities—however generous they may be—that are needed or appreciated by workmen, such as the founding of libraries and starting workingmen's clubs, so much as small acts of personal kindness and sympathy, which establish a bond of friendly feeling between them and their employers.' These sentiments have been the ruling factor in my firm since we began business, now fifty years ago, and when I tell you that no strike has occurred in our works since the year 1877, you may take it as a proof that our system of management, working on these lines, has not been unsuccessful.

"To be a successful business man requires a combination of qualities. It requires at the very beginning a certain knowledge of business methods and means, and none, perhaps, is so important as to understand the system of costing and cost keeping. This is too large a subject for me to enter into fully; there is only one point which is of such primary importance that I wish to deal with it in some detail. I refer to the question of charges—standing charges, as they are sometimes called. These charges vary in various businesses and in various localities. Roughly they may be classified under the following heads: (1) Conveyance; (2) coals; (3) stationery and printing; (4) gas and lighting; (5) repairs on buildings; (6) repairs on plant; (7) general upkeep and repairs; (8) naphtha, waste, oil, etc.; (9) stamps and telegrams; (10) water; (11) taxes and rent; (12) fire and boiler insurances; (13) salaries administrative; (14) salaries technical; (15) salaries commercial; (16) travelling expenses; (17) upkeep of contracts; (18) cleaning offices and sundry; (19) extra charges; (20) legal expenses; (21) depreciation. Different men consider different items as fixed charges, but the list I have given you is not an uncommon one.

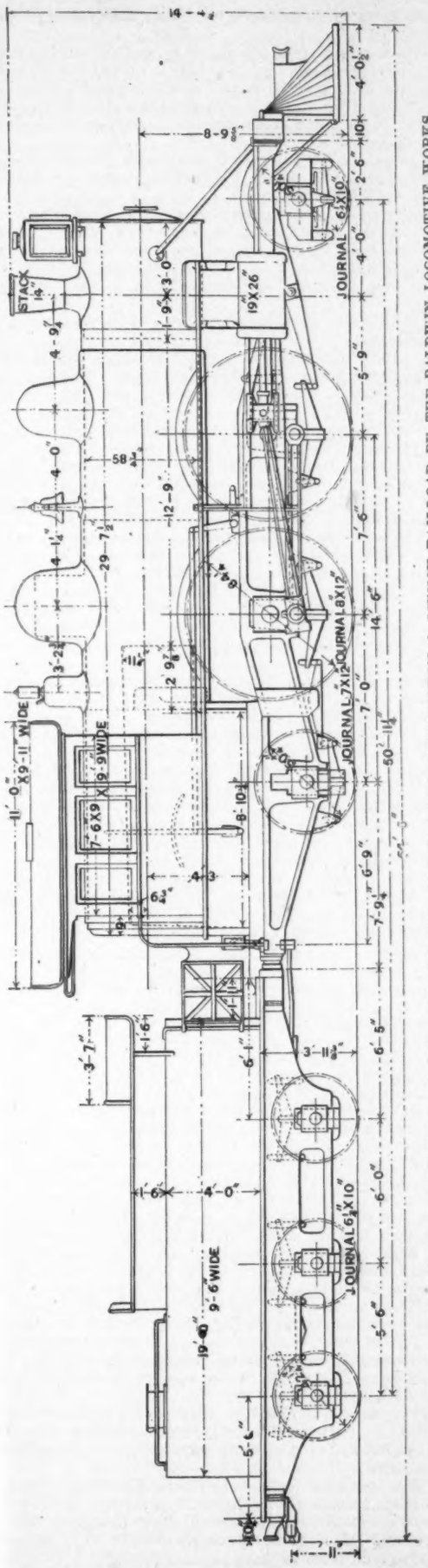
"The following explanatory remarks may be useful: (1) Conveyance: This is for carriage of material to and from the works. Of course, most supplies are bought carriage paid; some cannot be treated in this way, and in dispatching goods the expenses must be met. (2) Coal: This is one of the items which bulks largely in most businesses, and should be carefully watched. The quality of coals is one of the principal items, and carelessness on this head will soon run up a heavy bill. In a large business you will find it pay to have one man devote a large proportion of his time to watching this item alone. (3) Stationery and printing is an item apt to grow, and one in which the staff, more than the principal, can exercise economy. (4) Gas: You will find it useful to read your metre or metres every week; large leaks are likely to occur, which can only be checked in this way. (5 and 6) Repairs on building and repairs on plant are largely dependent upon the skill and care of the manager. (7) General upkeep and repairs: These items, which belong to neither of the other two, consist in small jobbing accounts which can grow if not watched. (8) Naphtha, waste, oil, etc.: It is better to have these separate item in charges, rather than to attempt dividing them over each job. (9) Stamps and telegrams: The telegram bill must be watched. (10) Water: The same remark applies to this as to gas. (11) Taxes and rent are largely uncontrollable. (12) Fire and boiler insurances: Too much economy in this may lead to disaster in the event of an accident. (13) Salaries administrative: That is, those paid to manager, under-managers, etc. (14) Technical salaries: Those paid to drawing-office staff. (15) Commercial: Those paid to the counting-house staff. I shall deal with these two latter items more fully immediately. (16) Travelling expenses: The travelling expenses of the staff when for any definite job should be carried directly to that job. These carried to charges should be those only of the principal and manager, which are often incurred in looking for work which is not secured, or general travelling. (17) Upkeep of contracts: There is a good deal of chance and luck affecting this item. Of course, careful work in the first instance reduces it to a minimum, but it is frequently advisable in large risks to cover by insurance. (18) Cleaning of offices, etc., explains itself. (19) Extra charges, viz., those items which cannot be charged to any more definite account, such as special bonuses to employés or outsiders. (20) Legal expenses: I can only express the hope that this may be a small item, and advise you to avoid law even at the sacrifice of what you may consider strict justice in some cases. It is an old saying that the only man more to be pitied than the loser in a law case is the winner. (21) Depreciation: This is a most serious item, and one which cannot well be too large. If the partners in a business are of greatly different ages, it is to the advantage of the younger member and to the disadvantage of the older that this item should be large. The legal depreciation allowed by the income tax authorities is too small. Good practice is to take 10 per cent. off the original cost of all tools year by year until they are virtually written down to scrap price. If your business is to succeed, you must be continually adding new machines, and as it is not advisable to go on increasing your capital indefinitely, therefore your power of purchasing new machines must be largely derived from the depreciation of those you already have. If your buildings are substantial, 2½ per cent. may be enough provided that in both cases you upkeep your buildings and tools from revenue. Depreciation should be the first consideration, and division of profits should only come in after the depreciation account has been fully satisfied.

"In most businesses it is usual to find out by years of experience what roughly is the percentage these charges bear from year to year to the wages bill. The wages bill is chosen because it is less fluctuating than materials, and because it is some measure of your power of output—I mean how much work you can turn out. I will not go into detail for many reasons, but roughly, and as a guide to you, if you are ever called upon to decide this question, in ship-building, if you find these charges exceeding 30 per cent. it is time to carefully consider the position of affairs, and if you find them falling below 20 per cent. it is also time to look carefully into matters, and for this reason. One of the largest items under charges is salaries of draftsmen, clerks, managers, etc. Now you can either have this item too large or too small. If it is too small there will be insufficient supervision or insufficient plans; this will increase the total expense of working, the wages will rise, and apparently your charges will fall in percentage. On the other hand, it is quite clear, if the staff is too large, this leads directly to large charges, with probably a moderate wages bill. Staff should therefore be only pushed to such a point that the wages are kept a minimum by careful supervision; beyond this, increase of staff is a questionable advantage. I am not so cognizant of what charges should be in a marine engine works, but from what I can learn you would require to study the position of affairs should they exceed 30 per cent. of the wages. I do not lay these down as fixed limits; charges largely depend upon the size of the business, the amount of turnover, and I have been considering medium sized concerns, but they will be some guide to you starting with probably little experience.

"My final advice to you is to make your work your first business, but do not allow it to entirely absorb your attention; you should have some harmless hobby or amusement to which you can turn your attention when the day's business is done; you should not always carry your business on your shoulder like the 'old man of the sea.' In business be careful of the small things; they are sometimes more important than the larger issues. While pushing forward with all the energy you possess, be thoughtful for and careful of others less favored than yourself; and finally, while I am not enamored of Latin, I would like to sum up the matter in two words often used to me by one of my best friends, and excellent advice it is for young men—*Festina lente.*"



EXPRESS PASSENGER LOCOMOTIVE FOR THE CHICAGO, BURLINGTON & QUINCY RAILROAD, BUILT BY THE BALDWIN LOCOMOTIVE WORKS.



OUTLINE OF AN EXPRESS PASSENGER LOCOMOTIVE BUILT FOR THE CHICAGO, BURLINGTON & QUINCY RAILROAD BY THE BALDWIN LOCOMOTIVE WORKS.

NEW EXPRESS PASSENGER LOCOMOTIVE FOR THE CHICAGO, BURLINGTON & QUINCY RAILROAD.

THE two engravings which we give with this number represent a new express locomotive ordered some time ago by Mr. Godfrey Rhodes, the Superintendent of Motive Power of the Chicago, Burlington & Quincy Line, of the Baldwin Locomotive Works. It will be remembered by some of our readers that in the June number of the AMERICAN ENGINEER there was published an illustration of an engine of this general type, but with a four-wheeled leading truck. This engine was built for the Concord & Montreal Railroad. In our issue for July we published engravings of an ordinary American type of locomotive, built by the Schenectady Company for the same road and for the same service. This being the case, notwithstanding the fact that comparisons are odious, there will be an inquiry as to which of the two classes of engines are best adapted to the service in which they are employed. Up to the present time we have no data bearing on this point. In the number of the paper, however, in which the Schenectady engine was illustrated, we ventured to comment on the two engines, and in the article containing these comments it was said :

"The writer confesses to a predilection for a design of locomotive similar to that which the Baldwin Works have adopted. A concession, however, had to be made by them to the impression that a four-wheeled leading truck is essential for safety in a high-speed engine. This makes it difficult to get all the advantages which would result from this general plan if it was somewhat modified. It will be remembered that the *Columbia*, which the Baldwin Company exhibited at Chicago, had a leading truck with a single pair of wheels in front. With this arrangement and by moving the driving-wheels about a foot farther forward, the fire-box would be entirely behind the back pair. If a pair of trailing wheels of 36 in. in diameter were substituted instead of the 50-in. wheels which were used, the fire-box could then be made as wide as might be desired, and therefore shorter than it was in the engine for the Concord Road.

"We have quoted a number of times in these pages a paper written about two or more years ago by Frederick Siemens, in which he showed that whenever flame came in contact with any solid substance combustion was partially arrested, and that in all furnaces we should aim to keep the flame out of contact with their sides until the process of combustion is completed. The inference from this was that a sphere would be the ideal form for a furnace, and in fact that is approximately the shape adopted in the ordinary egg-shaped stoves for burning bituminous coal. But as a sphere would not be a convenient form for a locomotive fire-box, and as a cube is the closest approximation thereto that existing shapes will admit of, the inference is that it might be well to make locomotive furnaces of such dimensions that their height, length and breadth would all be equal. This would be possible with a locomotive of a design similar to the *Columbia*, and it is believed would make a very efficient engine. The plan permits the driving-wheels to be placed as close together as the flanges of their wheels will allow. The coupling-rods may therefore be correspondingly shortened. These wheels being under the middle of the engine, they can be loaded with as much or as little weight as may be desired, and a liberal length of tube would be provided."

From the quotation and our illustrations it will be seen that Mr. Rhodes and the Baldwin Locomotive Works have embodied the suggestions which were made last July in the engine which has recently been put in service on the Chicago, Burlington & Quincy Road, and which is illustrated herewith. Now, it is not intended to intimate that the peculiar features of this machine were adopted because they were suggested in these pages, as Mr. Rhodes, and doubtless the engineers of the great Philadelphia engine works, had probably long before that evolved out of their inner consciousnesses the same inferences that we did ; but as the engine before us embodies these features, it will be very interesting to know how near she comes to fulfilling the predictions which we ventured to make. This is written with a full consciousness of the danger of submitting prophecies to the actual test of fulfilment, but this was assumed when the predictions were made, and Mr. Rhodes' experience will indicate whether there has been any false predictions. It should be said that Mr. Rhodes has for a number of years been hauling heavy express trains with mogul engines, and no longer entertains the superstition which is so common among railroad men in this country of thinking that it is not safe to run a locomotive at high speed with a single axle truck leading, and has, therefore, had this feature adopted in the engine under consideration, of which the following is the

SPECIFICATION.

Cylinders, 19 in. in diameter and 26 in. stroke; driving-wheels, 84½ in. in diameter; gauge, 4 ft. 8½ in.; fuel, soft coal; total wheel-base, 24 ft. 3 in.; driving-wheel-base, 7 ft. 6 in; rigid wheel-base, 14 ft. 6 in.*; total wheel-base of locomotive and tender not to exceed 51 ft. 0 in.; weight in working order, total about 138,000 lbs.; on driving-wheels, about 84,000 lbs.; weight of tender, with fuel and water, about 90,000 lbs; weight on trailing wheels, 33,000 lbs.; limits of height 14 ft. 6 in.

The boiler is of the straight-top type with radial stays for the crown sheet, and it is made throughout of flange plates of homogeneous cast steel 1⅛ in. thick; all of the longitudinal seams are butt jointed with double covering strips caulked inside and outside. The throat sheet is ½ in. thicker than the shell of the boiler to prevent undue thinning where flanged. The working pressure is 200 lbs.

The waist of the boiler is 58½ in. in diameter at the smoke-box end, and 57⅜ in. at the inside diameter of the smallest ring. The dome has an outside diameter of 2 ft. 8½ in. and a height of 2 ft.; it is located centrally. The dome ring is of pressed steel 1 in. thick. The tubes are of iron of No. 11 B. W. G. thick, with copper ferrules on swaged ends in the fire box tube-sheet. They are 210 in number and 2 in. in diameter, 12 ft. 9 in. long.

The fire-box is 8 ft. 10¼ in. long by 5 ft. wide on the inside, 5 ft. 2½ in. deep at the front and 4 ft. 9¾ in. deep at the back, and is made of homogeneous cast steel which was annealed after flanging; side and back sheets, ⅜ in. thick; crown sheet and tube sheet, ½ in. thick; flue sheet, ½ in. thick; water space, 4 in. sides and back, 4 in. front; stay-bolts of iron, 1 in. in diameter, screwed and riveted to sheet, and not over 4 in. from centre to centre; fire-door opening formed by flanging and riveting together the inner and outer sheets; tool-guard to be cast on lower part of fire-door frame; fire-brick arch in combustion chamber.

Crown stayed by radial stay-bolts 1⅛ in. in diameter, not over 4 in. from centre to centre, screwed through crown sheet and roof of boiler, and riveted over. The heating surface of the fire-box is 187.4 sq. ft.; of the tubes, 1,392.72 sq. ft., giving a total of 1580.12 sq. ft. Dry steam pipe inside boiler of wrought iron. Steam pipes in smoke-box, cast iron. Cleaning plugs in corners of fire-box. Balanced puppet throttle valve of cast iron, in vertical arm of dry pipe.

Grates, rocking and drop, and have an area of 44 27 sq. ft. Ash-pan, with front damper, slides in bottom.

Smoke-stack straight.

Smoke box, extended, with netting, deflecting-plate and spark hopper.

Frames of steel, made in two sections, and spaced 3 ft. 7 in. from centre to centre. Front rails bolted and keyed to main frames, and with front and back lugs forged on for cylinder connections. The bumper beams on the engine are 9 ft. 9 in. long. Pedestals forged solid with main frames and protected from wear of boxes by cast-iron gibs and wedges. Pedestal cap lugged and bolted to bottom of pedestals.

The trailing wheels are 4 ft. 2½ in. in diameter with steel tires held by shrinkage and retaining rings to cast-steel centres. The journals of the axles are 7 in. × 12 in. At the front there is a centre-bearing swivelling two wheeled truck with a radius bar. The truck frame is of wrought iron, with braces of wrought-iron fitted with a swinging bolster. The two steel-tired wheels with cast-steel centres are 4 ft. 2½ in. in diameter. The axle is of hammered steel, with journals 6½ in. in diameter, and 10 in. long.

The springs are of crucible steel tempered in oil, and are connected by equalizing beams resting on the top of the boxes.

The cylinders are spaced 7 ft. 1 in. transversely from centre to centre, and each is cast in one piece with a half saddle placed horizontally, the right and left-hand cylinders being reversible and interchangeable. The cylinders and air pump are oiled by a Nathan triple automatic sight-feed lubricator placed in the cab and connected to the steam-chest by copper pipes running under the jacket. These pipes are proved to a pressure of 200 lbs. The steam pipes have a sectional area of 25.9 sq. in., and the valves are of the piston type with a maximum travel of 6 in. The lead is $\frac{1}{32}$ in. in full gear and the lap 1 in. The pistons are of cast iron with an approved form of packing, and have a clearance of ¼ in. at each end. Jerome metallic packing is used for the piston-rods and valve stems.

The guides are of steel fitted to a wrought-iron guide yoke. The crossheads are of cast steel.

* One quarter in. extra play on trailing wheels.

The shifting valve motion is used with links having a radius of 5 ft. 2 in.

The main valves are of the piston type, 10 in. in diameter.

The driving-wheels are 84½ in. in diameter, and their centres are of cast steel turned to a diameter of 78 in. The tires are held by shrinkage and retaining rings; they are of cast steel 3½ in. thick when finished. Both pairs are flanged and are 5½ in. wide.

The axles are of hammered steel with journals 8½ in. in diameter and 12 in. long. The driving-boxes are of steeled cast iron with brass bearings.

The connecting and coupling-rods are of open-hearth steel. The crank-pins are of steel, the main pins being 6 in. in diameter and 6 in. long, the wrist-pin being 3½ in. in diameter and 3 in. long. The front side-rod pin is 5½ in. in diameter and 4 in. long, and the back pin is 6½ in. in diameter and 4½ in. long.

The feed water is supplied by one 9½ in. and one 10½ in. Sellers injector.

Engine to be furnished with one sand-box and Leach sander, stand for head lamp, bell, West bell-ringer with self-acting lubricator, whistle, blow-off cock, blower and two 3-in. Richardson sealed safety valves, two steam-gauges, cab-lamp, gauge-cocks; also a complete set of tools, consisting of two heavy jack-screws and levers, one heavy pinch-bar with steel point and heel, complete set of wrenches to fit all nuts and bolts on engine, including two monkey-wrenches, one set of driving box packing tools, one machinist's hammer, one soft hammer, three cold chisels (two flat and one cape), one long-spout quart oil-can, one two-gallon oil-can, one tallow-pot, one torch, engineer's arm-rest, one extra fusible plug, one bell-cord, cab-seats, cab-seat cushions, one poker, one scraper, one slice-bar, and one scoop shovel, headlight with 22½-in. reflector, two water gauges and lamps, Westinghouse-American outside equalized brake on driving, trailing and tender wheels, 9½-in. pump, and train signal.

Six-wheeled tender. Tank of steel or iron, strongly put together with angle-iron corners, and well braced. Top, inside and bottom plates, ¼ in. thick; outside plates, $\frac{3}{16}$ in. thick; riveted with $\frac{7}{16}$ in. rivets, not over 1 in. and 2 in. pitch. Capacity, 4,000 galls. (of 231 cub. in.). Shape of tank, U. Roof over tender. Tender frame substantially built of steel strongly braced. Six wheels working in pedestals. Wrought-iron centre steel tired wheels, 42½ in. in diameter. Brakes on both trucks. Axles of steel; outside journals, 6½ in. in diameter and 10 in. long. Oil tight boxes and brass bearings. The Janney coupler is used at the rear.

The total weight of the engine in working order is 138,000 lbs., of which 39,600 lbs. is on the front drivers, 46,600 lbs. on the main drivers, giving a total of 86,200 lbs. in all. The trailers carry 31,800 lbs. and the front truck 20,000 lbs.

SHOP NOTES.

At the meeting of the Western Railroad Club, held on November 19, Mr. Bell's paper on Wide Fire-boxes was discussed. Mr. Rhodes, of the Chicago, Burlington & Quincy Railroad, gave the experience which he had on that line with two engines having Wootten fire-boxes. With screened coal—such as was used in other locomotives—these engines failed to steam when pushed, owing to the formation of holes in the fire-bed, through which the air was drawn; but when fired with slack coal and screenings such as the other engines could not use, the Wootten boilers were excellent steamers. After a protracted trial on the road, this class of boiler was condemned, not as above stated on account of bad steaming, but because they had no supply of the kind of fuel which these boilers were adapted for, and also on account of the large amount of boiler repairs which they required compared with other engines. On that account he characterized them as "shop engines" and not as "road engines." He attributed this unsatisfactory boiler service to the character of the water found on the line of their line, and he had every reason to believe that they would have been entirely satisfactory using the water found on Eastern railroads, where they originated and are still in successful operation.

Mr. Forsyth and Mr. Gibbs were of the opinion that the best results were obtained with locomotive boilers when from 100 lbs. to 125 lbs. of coal were consumed per square foot of grate per hour.

In a discussion on freight-car doors, Mr. Waitt considered that all side doors should be hung from the top, as several accidents had occurred on his road by doors becoming detached while passing other trains. Such doors were dependent upon a rabbet to hold them in place at the top.

CHICAGO, ROCK ISLAND & PACIFIC RAILROAD SHOPS.

Mr. Wilson Superintendent of Machinery of the Chicago, Rock Island & Pacific Railroad, is, so far as we are aware, making more use of compressed air in his shops than any other person occupying a similar position, although Mr. Player, of the Atchison, Topeka & Santa Fé Road, and Mr. McConnell, of the Union Pacific, have the reputation of using compressed air whenever it is possible. Mr. Wilson's compressor, which is used at the Chicago shops, was built by Edward P. Allis & Co., of Milwaukee, and is operated by the stationary engine which drives the shop shafting. The piston-rod of the air-pump is attached to the piston of the engine, which has a stroke of 42 in. The air cylinder is 12 in. in diameter, and the valves are of the Corliss type. When the maximum pressure of 105 lbs per square inch is reached, a further increase of air pressure is prevented by an automatic valve, which allows the air to escape from the cylinder before it enters the distributing mains, which are altogether about four miles in length. In the erecting and machine shop there are 26 air lifts of various kinds and sizes for handling everything heavy that must be machined or moved from place to place. In the various shops there are about twenty air-driven engines of different types and for various purposes—from three-cylinder engines for driving flexible shafting to small breast drills. In addition to these there are many special tools also air-driven, such as the Baird stay-bolt breaker, stay-bolt cutters and foundation-ring miller, a machine for bending to standard shape the 3-in. brick-arch circulating pipes, a metal stamp in the tin shop, a device for holding brasses when they are being lined with lead, a punch for cutting rubber gaskets, etc.

The compressed air is conducted to the car repair yard, about half a mile from the compressor. Here it is used for boring holes in timber, for operating a drop pit for changing wheels as well as for testing air brakes. A number of reservoirs are located at different points in the shops for storing up the required amount of compressed air. These are made of the cylindrical portion or waists of old boilers, and are of various sizes up to 12 ft. in length. Compressed air is used for charging the boilers of repaired engines, so as to enable them to move themselves from the erecting shop into the round-house.

The result of using compressed air for operating special tools in the boiler shop is that the labor required to remove and replace a 6-ft. fire-box has been reduced to about $180.

In the smith shop an unusual amount of work is done with the "bulldozer." There are three bolt headers of the company's make, one taking in 2¼-in. iron. There are three Bradley 200-lb. hammers, one 2,500-lb. hammer, one 1,500 lb. steam hammer, one 1,200 lb., one 1,000 lb. and one 800 lb. At the present time there are only 12 fires in operation, the majority of the work being done in heating furnaces in conjunction with the above-mentioned hammers. Oil is about to be introduced as fuel for these furnaces.

An excellent time-saving device for heating tires is operated by carbureted air. Ordinary gasoline, such as is used in cooking stoves, is brought into contact with a jet of air, which forms the gas used. The time required to remove a tire depends upon its thickness, and varies from 8 to 20 minutes.

At the Chicago shops, Mr. J. W. Fitzgibbon, Master Mechanic of the Illinois division, takes care of 150 engines, and does all the cylinder and crank-pin work for the whole system as well as the renewals of fire-boxes. The standard eight-wheeled passenger engines have 18 × 24-in. cylinders and 5 ft. 9 in. wheels. The heavy passenger engines are 10-wheelers with 19½ × 24-in. cylinders and 5 ft. 9 in. wheels. To handle faster trains, Mr. Wilson is about to design a still more powerful class of engine. A steam pressure of 170 lbs. is carried on all new passenger engines. Particular attention is paid to boiler and stay-bolt inspection.

CHICAGO & NORTHWESTERN RAILROAD SHOPS.

In the Chicago shops of this company the men are now working nine hours.

Since Mr. Quayle took charge of the motive power department of this road he has turned most of his energy in the direction of fuel-saving. As the annual amount of the coal bill is about $3,000,000, it can be readily seen that even a saving of 1 per cent. will be worthy of an effort

By means of a circular letter issued in February last, and addressed to the engineers and firemen, Mr. Quayle called their attention to the "great importance of using the coal burned on the locomotives of the company with the utmost care and good judgment, in order that every pound be utilized to the best advantage." He stated that there were engineers in the service who were costing the company upward of $1,000 per year more for coal burned on the engines run by them than other engineers running the same kind of engine in the same kind of service. Mr. Quayle, after speaking of the necessity for the existence of the very best of feeling among the officers and men, and between the engineer and fireman on the same engine, in general terms describes the duties of the engineers and firemen and the ways in which fuel can be saved or wasted by either one of them.

By investigating individual cases he has been able, by changing men, to discover the man to blame for excessive coal consumption, and in some cases inculpating the engineer; in others the fireman; and sometimes the conductor, who by wasting time at stations, rendered fast running, and consequent waste of fuel, necessary.

Mr. Quayle has every reason to believe that the effect of his circular and investigations will be very satisfactory.

His company has recently received some heavy eight-wheeled passenger engines from the Schenectady Locomotive Works. One of them, when indicated recently at a speed of 72 miles per hour, developed 1,268 H P. These engines have 19 × 24-in. cylinders, 75-in. driving-wheels, 36-in. truck wheels, and carry 190 lbs. steam pressure. The front course of the boiler shell is 62 in. outside diameter, and the wagon top is 72 in. in diameter. In working order these engines have 81,450 lbs. upon the drivers and 45,950 lbs. upon the truck. The wheel centres are of cast steel, as are also the cross-heads, which are cored out, and made as light as possible. The main and side-rods are fluted, and weight in them has been reduced to the utmost.

Some engines on the road which have 20-in. ports and Allan Richardson valves have been giving trouble from excessive cutting of the valves and strips on the edge nearest the outside of steam-chests. Upon investigation, it was decided that the trouble was caused by want of proper lubrication on that part of the valve; and to test the correctness of the theory, the lubricator pipes were disconnected from the centre of the steam-chest covers, and holes were tapped into the steam ports at the junction of the saddles with the cylinders of two engines. The experiment showed that Mr. Quayle's hypothesis was correct, as the trouble has disappeared, and the engines can be hooked up without any undue difficulty.

As these steam-ports, steam-chests, balance-plates and valves are not at variance in design to corresponding parts of other engines as generally designed, this experience would indicate that the centre of the steam-chest cover is not the best location for the delivery of oil from the lubricator, and that the trouble that was excessive in the case of these engines—owing, perhaps, to high steam pressure and large valves—exists more or less in all steam-chests, and should be looked into and the proper remedy applied

Mr. Quayle has installed in one of the round-houses an engine-testing device of the same character as that used by him at Kakanna for blast-pipe and stack experiments, only of a permanent and more useful nature than the original. It is arranged with three pairs of carrying wheels, the centres of all which being adjustable, enables him to test any build of four or six-wheel coupled locomotive. The latest addition to this plant is the use of a governor for regulating the pull on the friction-brake and speed of the engine wheels. Its use has enabled him to control the speed within one-quarter mile per hour, showing a straight line on the Boyes speed recorder used in connection with the tests.

In the smith's shop an axle furnace is kept running day and night on car axles—a large proportion of the axles used, not only for repairs but also for new cars, being made by the company. Crank-pins and piston-rods are also made from selected scrap in these shops In fitting piston-rods into cross heads no shoulder is left on rods, but the taper is allowed to run out outside the cross-head; and Mr Quayle has introduced the good plan of making the large diameter of the fit of a greater diameter than the body of the rod; and, following in the same line, is making the wheel fit of his engine axles considerably larger than the journals, thus getting over the tendency to break at the face of or inside the hubs of the wheels. Of course this is nothing new in locomotive design it being the regular practice in England and the continent of Europe, but is a departure from the deep rut that has been followed for economical construction purposes in this country.

A new departure in lathe tools is likely to follow the experiment of using a small section of tool steel mounted in a carrier or holder of a cheaper material, thus reducing the stock of high-priced tool steel to a minimum. Messrs. Pratt & Whitney have, we believe, followed and advocated this system for many years.

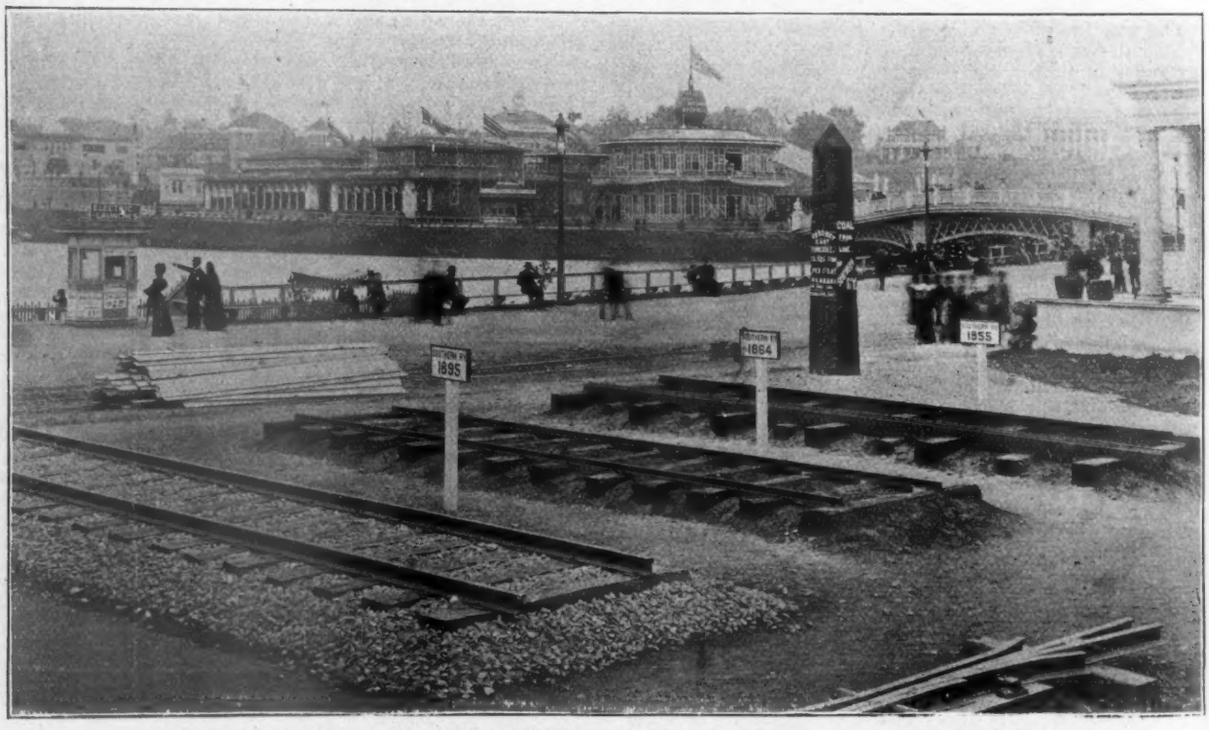
ILLINOIS CENTRAL RAILROAD SHOPS.

One of the novel appliances in these shops is the filling of

oil cans from the storage tanks in the cellar by air pressure. Instead of applying the air pressure directly to the large tanks, it is applied to the upper end of a closed pipe about 8 in. in diameter, the lower end of which is connected by a pipe and check-valve with the bottom of tank This stand-pipe is the same height as the tank to which it is connected. By opening a valve and releasing the air pressure upon the top of the oil in this pipe, the check valve opens and allows the oil in the tank to fill the pipe to the same level as it is in the tank. When an oil-can is to be filled, the release valve is closed and the pressure valve opened, admitting air upon the surface of the oil in the pipe, closing the check-valve and forcing the oil to a cock, from which it is drawn. By this means very little air is used each time it is turned on to force the oil to the level from which the cans are filled. Each storage tank has its "stand-pipe" from which a quantity of oil can be drawn at any time by the process above described.

THE ATLANTA EXPOSITION.

THE event of the year, if not of the decade, for the Southern States, is the Exposition now being held at Atlanta. It is peculiarly a Southern enterprise in which the whole South is interested and of which it is justly proud. Atlanta has borne the brunt of the burden and supplied the sinews of war with which the enterprise has been brought to a successful issue, while the whole country has contributed its quota of exhibits to attract the visitor and lend encouragement to the workers.



TRACK EXHIBIT OF THE SOUTHERN RAILWAY COMPANY AT THE ATLANTA EXPOSITION.

In this last the railroads of Georgia have been particularly active, and well they might be, for anything which tends to stimulate industrial activity in the country through which they run, to induce immigration and to develop the latent resources, must most directly bear upon their own revenues. But whether it be from these motives or from those of an enthusiastic co-operation without the hope of gain, it is a fact that the two great systems, the "Plant" and the "Southern," that centre in Georgia have exhibits worthy of attention.

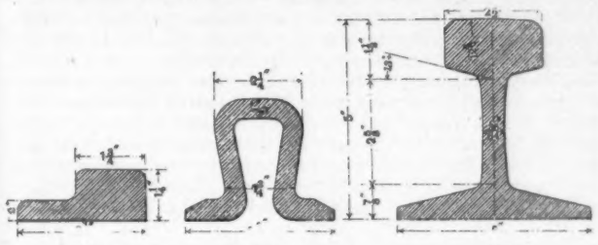
While the Southern has a fine exhibit upon the grounds, showing the resources of the country through which it passes, and to which a later reference will be made, a more interesting exhibit is to be found in the road itself as used by the visitor from the North on his way to and from the Exposition city. To any one who passed over the route as lately as three years ago, and then rides over it to-day, the change in the condition of affairs is most striking. At that time little could be said that would be complimentary to the motive power or the roadway. The engines were worn and sorely in need of repairs, and the track was one long call for new rails and sounder ties. At that time the schedules were comparatively slow and the cars hard to ride in. But new rails have been laid, fresh ties have taken the place of the old, the ballast has been brought up to surface, and broken stone is largely used; then, that the improvement may not be limited strictly to the essentials, the banks and slopes have been graded and smoothed, and, last, but by no means least, in the expense of maintenance and the preservation of the roadway, the ditches have been cleaned so that the drainage is what it should be. New engines and cars have been put in service, and for speed and accommodation the through expresses compare favorably with the best of other sections of the country.

On the grounds of the Exposition the Southern Railway has a fine building in which samples of the products of the States through which the road runs are shown. There is coal from Virginia, Alabama and the Jellico district of Tennessee; and that the dusky diamonds may not claim the sole attention, there are genuine diamonds from North Carolina and rubies from the corundum quarries along the line. Iron ores are exhibited from Alabama, North Carolina, South Carolina, Georgia, Virginia and Tennessee, with some samples of copper, lead, zinc and gold. The agricultural resources are shown in the wheat, corn, oats, rye, timothy, flax, and, of course, the tobacco and cotton. Outside the building there is an interesting progressive study in track construction, of which we present the reproduction of a photograph. There are three short sections of track, illustrating the roadway of what is now the Southern Railway in 1855, 1864 and 1895. In the first the rail used resembled the tram rail now commonly used upon horse railways, but much lighter than any that we have seen for a number of years, and which has been entirely discarded for electric roads. This light rail, which weighed only 21½ lbs. to the yard, was laid with the tram outward upon stringers 7 in. deep and 6½ in. wide. These stringers rested upon two types of sleepers. Into the larger and heavier of the two (x) the stringer (y) was gained to a depth of 4 in., and was held firmly against the outer edge of the gain by a wedge, z, that tapered from 4 in. at one side of the tie to 2 in. at the other. These main sleepers or ties were spaced about 4 ft. 8 in from centre to centre, and midway between them there was a smaller sleeper into which the stringers were not gained. The main ties were much the heavier, and averaged 10 in. × 10 in. No ballast was used above the bottom of the sleeper, and the imagination shudders at the weariness of a day's ride over this primitive track in the primitive cars of the time before the attention of car-builders had been directed toward the construction of a comfortable seat or the careful adjustment of the springs to the load that they would be called upon to carry.

The track of 1864 was laid with the old Barlow form of rail

that weighed about 42½ lbs. to the yard. It was spiked to ties, the stringers having been discarded and some improvements made in the disposition of the ballast. The surface of the latter rounded down from the top of the centre of the ties to the bottom ot the ends. It was dirt, not gravel, and apparently was procured from the most convenient locality, regardless of its quality. The bed was heavy and poorly drained, and had it been subjected to Northern frosts, the irregularities that it would have shown when heaving set in would have rivalled the typical ram's horn in its tortuousness. The joints were made by wrought-iron chairs held by four spikes; the rail itself being held by two at each tie, these latter being spaced 2 ft. 6 in. from centre to centre.

It would be interesting if we could have had a series of exhibits showing the gradual improvement in the roadway from 1864 down to 1895, when we find that the standard is well up



RAIL SECTIONS OF SOUTHERN RAILWAY TRACKS.

to the best of modern requirements. Broken stone ballast, ties with 10-in. face and spaced 2 ft. 4 in. from centre to centre, the Servis tie-plate on every tie, rails weighing 80 lbs. to the yard, angle-bar rail joints and first-class surfacing. Our readers know what this represents, and the accompanying engraving illustrates the three gradations of track with great distinctness.

The exhibit of locomotives and cars is an abridged edition of some of the exhibits at Chicago. The Pullman Company show a vestibule train that may be the identical one that attracted so much attention in 1893. The Plant system of railways also have a passenger train on exhibition, but neither of these present any striking features with which our readers are not already familiar. They are merely examples of the latest

SECTION OF 1855 TRACK OF SOUTHERN RAILWAY.

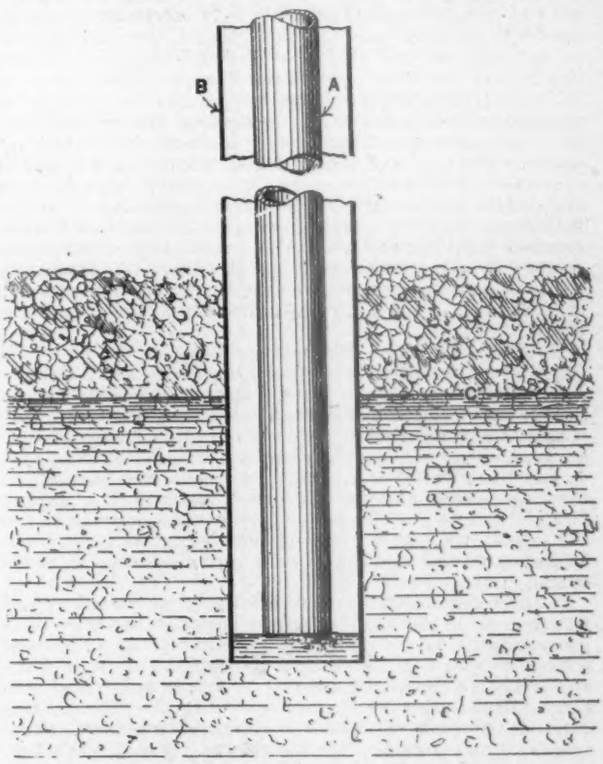
product of the best practice in passenger-car building. The exhibit of the Plant system also includes a model freight train built upon a scale of about one-half size, and representing the standard locomotive that is used, with the various types of flat, gondola, and box cars, with typical loads in miniature, and a plainly printed notice giving the tonnage of cotton, lumber, resin, coal and other products that have been handled by this road during the last fiscal year.

There are some fine examples of locomotives in the transportation shed. There is a compound built by the Baldwin Locomotive Works that is under steam and with drivers in motion. The Richmond Locomotive Works also exhibit a compound, and theirs is the one that has been undergoing a trial in service on so many roads and which has produced such satisfactory results. Each of these two firms also exhibit simple engines, and there is one of these by the Rogers Locomotive Company which has the peculiarity of having both injectors upon the right-hand side and delivering into a double check valve held by a single casing. One injector is inside the cab in the usual place, while the other is outside above the running board.

In Machinery Hall there is a fine exhibition of modern machinery of great variety. Probably the largest is the pumps that are at work supplying water for the fountains and other uses about the grounds. These are now delivering about 21,000,000 galls per day, and though only the larger sizes are at work, the exhibit includes everything down to the small feed pump that could readily be carried under the arm. One thing that lends attractiveness to the hall is the location of the shafting beneath the floor, where it is out of sight, and where it can be watched and oiled by the attendants without interruption or annoyance.

In this review it is merely possible to mention a few of the more striking machines, some of which will be illustrated in detail in future issues. The engines, of course, occupy a prominent place, and are nearly all engaged in driving the dynamos that furnish the light for the building and grounds. Among those to be seen are two fine Corliss engines built by Lane & Bodley and the Frick Company respectively, several Westinghouse engines, a tandem compound by the Harrisburg Foundry & Machine Works, and a vertical compound by the American Engine Company.

There is one exhibit illustrating the increasing range in the use of compressed air that is made in connection with the Bacon system of increasing the flow of artesian wells by the Knowles Steam Pump Works. The apparatus on the ground is pumping water from a cistern 50 ft. below the level of the floor. An air compressor supplies air at a pressure of 10 lbs. per square in., and the delivery is 250 galls. per minute. With a pressure of 35 lbs. per square inch, 100 galls. per minute can be raised from a well 250 ft. deep. The water is literally blown up, and in order to explain the operation we refer the reader to the accompanying diagram. *A* is the water pipe, and outside it the casing *B* is sunk so that the lower end of the latter is a trifle below that of the former. In the water-bearing strata the water level is supposed to stand at *C*, and it will have a constant tendency to rise about the bottoms of the pipes and enter them. The compressed air that is forced down



BACON COMPRESSED AIR SYSTEM OF PUMPING.

between the casing and the water pipe drives the water before it, and, as it turns at the bottom to enter the inner pipe, it catches the water at that point and carries it with it in its rush to the surface. The system has been extensively introduced in the South for increasing the flow of artesian wells.

Machine tools are sparingly exhibited, and nothing outside the range of standard stock machines are shown. There are some fine examples of wood-working machinery, but it is confined to planers and sanding machinery; and nothing is presented in the way of a saw-mill equipment, as would be naturally expected at an exhibition held in a section where the lumber interests are still of such magnitude as they are in Georgia. As we have said, there are a number of fine exhibits of special machinery that have been left unmentioned in this review because illustrated descriptions of them will shortly appear in our columns.

We cannot close without one word of criticism on this and of suggestion to the promoters of future expositions of this class. The first impression, even at this late day, that the visitor has upon entering the grounds is that of their unfinished condition. It is a lamentable characteristic of the American people that they do not allow themselves sufficient time for

the proper consummation and execution of a work of this kind. What is true of the Atlanta Exposition was equally true of those held at Philadelphia and Chicago. None of them were even presentable on the opening day, and for weeks afterward there was confusion on every hand, and hurried work was the result. In this respect it would be well for us to take a lesson from the French, who began their preparations for the Exposition of 1900 in 1893, and actually settled on the time a year before that: while for the great Chicago Exposition nothing was really done until 1891. This may be taken to demonstrate that we are more active than others, and do not require so long a time; but the question may well be asked whether, with our hurried exertions and rapid adoption of plans that are not fully matured, we turn out as finished a product and one that is as pleasing to our visitors as do those people who spend more time in deliberation and do not act until every phase of the subject has been carefully considered.

The Atlanta Exposition is, of course, comparatively small, but it is well worth visiting even at the expense of some minor comforts that more forethought on the part of the management could have readily provided.

THE STORAGE BATTERY FOR CENTRAL STATIONS.*

By Arthur E. Childs.

The object of this paper is to bring before the Institute the main facts and considerations concerning the application of accumulators in electric generating stations both for light and power. The fact that storage batteries have reached a point of high efficiency and low cost of maintenance has stirred up engineers in this country to consider the application of storage batteries to their own plants, and thus the accumulator has assumed great importance at the present time, especially as power and light stations are so far developed that further increase in generating capacity means large additional expenditure, and in a great many cases the rebuilding of the entire plant.

Realizing, therefore, that storage batteries are eminently practical as auxiliaries, and that their utility and value are acknowledged throughout Europe, it is not surprising that engineers and managers in this country are inquiring about them with the end in view of securing the full measure of their advantages and benefits. In England and on the Continent, storage batteries have been used in central stations for more than five years, and the success of their application has brought about a great change of feeling regarding them; and the respect with which they are now regarded is an ample indication of the value they have been to managers in the operation of their stations.

It is an acknowledged fact that the great variations and fluctuations of the load on power circuits, especially those power circuits supplying trolley lines, are among the greatest difficulties which engineers have to contend against, and any appliances which will aid them to arrive at a satisfactory running of their station is looked upon with favor by them. It is only in the ranks of those short-sighted engineers, where ignorance and prejudice are the rule rather than the exception, that there are found men who will refuse to consider the storage battery as an auxiliary.

In this paper the term "variation" is used to designate the change of current induced by the adding of lights on to a lighting station, or the cars or motors on to a power station. The term "fluctuation" is used to indicate those rapid and necessary changes of current taking place on the outside line, due to stopping or starting of cars or throwing on or off of stationary motors. Although they may be thus differentiated, they bear a certain relation to each other, and in applying a storage battery a study of the conditions will quickly indicate the type of battery which will be more favorable in each case. By the "type" of battery is meant the slow discharge battery for a long period of service, or the rapid discharge battery for a few hours, or even less time of discharge.

In the lighting station, if we bear in mind the usual form of curve, it will be remembered that the instantaneous changes of current are minute and almost imperceptible compared with the steady increase or diminution of the total current of the station. Comparing the lighting curve with the usual form of power station curve, it will be noticed that the instantaneous changes of current are enormous compared with that in the lighting station curve. There is a similarity in the two curves in the fact that at certain hours of the day more cars are operated than at other hours, thus producing a general rise in the level of the power curve corresponding to throwing on of a number of lights in the lighting curve.

It is not the purpose of this paper to discuss the characteristics of the two curves, but to consider in a general way the application of storage batteries to the wiping out of the fluctuations and variations as they come upon the dynamos and engines. The introduction of a storage battery into a central station acts in a certain sense as a buffer between the external load and the dynamos, taking the shock of the variations without throwing the same on the engines. In this regard they have the effect of reducing the average percentage variation in load on the dynamo from a large amount to a very small one, making the operation of the machines more efficient. In fact, a storage battery acts as a regulator in this instance, maintaining as it does a constant voltage at the switchboard. This introduces the question of the efficiency of engines with varying loads; and, leaving out of account the reports by engine builders, who are naturally interested parties, it is a fact that not many extended and careful investigations of efficiency under varying loads have been carried out. Professor W. C. Unwin, of the Central Institution, at South Kensington, has shown, however, that a decrease of mechanical efficiency has a serious effect on the economy of working with a variable load, and with a load varying from 100 per cent. to 25 per cent., the efficiency decreases from 85 per cent. to 40 per cent.

As applied to power stations, and especially where water power is used, storage batteries are almost indispensable. The writer knows of several plants where the successful maintenance of a constant voltage on the machines is dependent upon the fact that an attendant sits by the governors of the wheels, and regulates them by hand, as the inertia of the water, even when the best water-wheel governor that has ever been produced is employed, is too great to allow the turbines to pick up or throw off the load with anything like the quickness with which it is thrown on or off by the outside circuit. The stations in mind are not small stations, as might be supposed at first thought, but are stations where several thousand H.P. and over are generated at certain hours of the day; and it is surprising that engineers of intelligence, who are usually quick to perceive the advantages of new applications, are still allowing their prejudices to prevent them from investigating the merits and value of accumulators as regulating governors in their stations.

In the application of storage batteries to the power station of a trolley system, it is not unusual to find the variation in load as much as 50 per cent below the average H.P., and even as great as 200 per cent. above the mean load. These enormous fluctuations take place in the course of a few minutes, and are an expense to the railroad companies in at least three ways. In the first instance, they require the use of a dynamo capacity very much in excess of that required where the station is operated at a constant load. In the second instance, these fluctuations reduce the life of the machinery of the station, producing a very large depreciation account. In the third instance, the efficiency of the generating plant is very much reduced, as pointed out in a previous paragraph. It has been figured out in a number of instances that could the steam be utilized in a proper manner in the engines driving the dynamos, that at least 40 per cent. more work could be obtained from it.

When considering the application of storage batteries to illuminating plants, it is found that their value is equally as great as in the case of power stations, as the charging of the battery can be done while the plant is operating at light loads, thus making use of the power of their machines to great advantage. At the period of heavy load, the battery is able to take care of the peak of the load, and also to operate the lights during that period of the 24 hours when few lights are being supplied from the station.

The value of an accumulator plant attached to an illuminating station has been thoroughly demonstrated by the New York Edison Illuminating Company, and the Edison Illuminating Company of Boston, and recently in the plant of the Lawrence Gas Company, Lawrence, Mass. In the latter case the battery is used in connection with their Edison three-wire system, and is used in the regular way of carrying the peak of the load during the busy hours of lighting. A secondary use of this particular battery is that at noon, when the large mills on the Merrimac at Lawrence shut down, they back up the water into the river above and entirely cut off the supply to the wheels of the gas company (for some 25 or 30 minutes), which are thus unable to operate the machines furnishing light and power until the overflow of the water which is dammed back comes down and allows the station to be oper-

* Paper read at the American Institute of Electrical Engineers.

ated. This short period of absence of water is taken care of by the storage battery plant.

The storage battery can also be used as a valuable adjunct to both power and lighting stations at points in their systems where it is difficult to maintain the voltage at periods of heavy load. In these cases the feeders are usually not sufficient to carry the whole current direct from the station. But during the periods of small load the feeders can be utilized up to their maximum allowable drop in potential to charge battery sub-stations placed at these weak points. When the load at such points becomes greater than the capacity of the feeder, the battery comes into play and carries the load in connection with the station supply at that point, thus maintaining the voltage and doing satisfactory and valuable service. There must be hundreds of street railroads in this country that have just such weak points, and it will only be in accordance with the established progressive character of American street railway and lighting engineers, to investigate the value to them of a storage battery, as soon as it has been brought thoroughly to their notice. This cannot but result in a widely extended use of the storage batteries for this purpose; and the expectations of those interested in storage batteries would not be exceeded if half the street railroads and direct current lighting plants in this country and Canada should adopt within the next few years storage batteries either at their central stations or at sub-stations, the more especially as they can now obtain storage batteries which are thoroughly reliable, and which can be installed under a guarantee.

The extent to which storage batteries have been used in England and on the Continent is very great; and it will surprise many engineers in this country to know that there are more than 20 lighting stations and several thousand isolated plants in Great Britain alone, using storage batteries. Further than this, there are in Germany 5,000 isolated plants and 15 railway power plants using storage batteries. In fact, 80 per cent. of all the central stations in Germany and Austria are equipped with storage batteries. In addition to the above, there are many stations in France, Italy, Holland, Belgium, Sweden, Norway, Denmark, and Spain, and two or three in Switzerland.

A survey of the progress which storage batteries have made in European countries, indicates no very great change in the principles of construction, but the results seem to be rather due to a thorough analysis and appreciation of the requirements of each case. This has resulted in a proper use of batteries and a correct recognition of the limitations of their usefulness. This fact alone has contributed largely to their successful application. The great difficulty in this country has been that engineers have not recognized a proper limit to the usefulness of a battery, but have, in many cases, far exceeded their specified limitations, and in this way have injured the batteries and cast discredit on them. It would be just as reasonable to overwork an engine until injured or worn out, and then declare that all engines were useless and expensive mechanical contrivances.

One point which has contributed largely toward the success of storage batteries in Europe, is the fact that engineers have endeavored to obtain long life and high efficiency even at the expense of increased first cost, and instead of attempting to obtain a large output per pound of element, they have limited themselves to a reasonable number of ampère-hours per pound. The result of this has been that the batteries in use in Europe have shown great endurance and solidity. The experience, however, which has been obtained with many American batteries has not been so promising as on the Continent, owing to the lack of proper appreciation of them. It would be greatly to the advantage of American engineers if they would follow the lines laid down by their European *confrères;* and if, instead of waiting for some marvellous development in the manufacture of storage batteries, they should make use of the existing high class and efficient batteries which are now offered to the public, and by using them in a reasonable manner they would obtain valuable and even remarkable results.

Great progress has recently been made in manufacturing large batteries which have a capacity large enough to take care of the needs of central lighting and power stations, and engineers need no longer complain that they are unable to get the large cells which they require. In fact, manufacturers can produce cells having almost any given capacity.

Considering the efficiency of a storage battery, the factors which tend to reduce it are due to a loss in voltage and in the quantity of current. These losses, however, are not so serious as they have been in the past, and manufacturers are at present able to guarantee a very high efficiency. In cells which were submitted to Professor H. L. Callender, an ampère efficiency of 96.1 per cent. was recorded, the watt efficiency being 84 per cent. In certain instances, however, known to the writer, these efficiencies have been slightly exceeded, and complaints from central station managers that they cannot obtain efficient cells are now groundless, as with the efficiencies named, an eminently satisfactory service can be obtained. It must be borne in mind that a loss of 16 per cent., or even 20 per cent., in the efficiency of the battery does not mean the loss of the same percentage in the output of the station, as the battery usually supplies, approximately, or even less, of the whole output in watt-hours, and it is, therefore, from that fraction of the whole output that the loss in the battery must be deducted.

In the matter of cost of maintenance of a storage battery outfit, it is now usual for the manufacturer to guarantee a fixed annual percentage. This percentage varies from 10 per cent. in small plants to a smaller percentage in large plants, depending, of course, on the conditions of operation and the use to be made of the battery, a study of which will soon determine what percentage can be guaranteed. In first-class plants well installed and operated by careful engineers, the cost of maintenance can be reduced to the vicinity of 3.5 or 4 per cent. It is customary for the manufacturers to enter into a contract, in the case of large plants, guaranteeing that the cost of maintenance shall not exceed a certain percentage per annum for the period of contract. This can be carried out in two ways. Either the lighting or railroad company can pay the manufacturer the percentage specified, every year, and the manufacturer will inspect and keep the battery in first-class condition; or the company employing the batteries can inspect and order renewals themselves, in which case should the cost of maintenance exceed the percentage guaranteed, the manufacturer will not charge more than the specified amount. This is an exception rather than the rule, however, as the cost of maintenance is usually somewhat lower than that specified by the manufacturers, so that the company owning the battery is the gainer by the difference in percentage. By a thorough attention to details, both large and small, the percentage can be kept down to a very low figure; and it is to be regretted that the practice of engineers which prevails in Europe, of treating the battery with care and consideration, does not seem to exist among the engineers of this country, to the detriment of their own lighting or railroad plants, which would otherwise be able to utilize batteries in an efficient manner.

It must not be assumed from the above that storage batteries require an inordinate amount of care and trouble. On the contrary, they do not require either expense or great care. All that is demanded is regular and systematic attention on the part of those having them in charge. When such care is exercised, it is found that batteries perform a very valuable service, and largely reduce the operating expenses of the station—in many cases as much as 30 to 35 per cent. This reduction in operating expenses is, of course, due to the saving in cost of coal consumed, a saving which could not otherwise be obtained. Where water power is employed, a storage battery enables the water-wheels to be operated for 24 hours, storing current while the station output is reduced to a minimum, and aiding the station during the busy hours of the day. In many cases this practically doubles the output of the station without increasing the cost of installation to a corresponding amount. In fact, in many cases where water power is used it would be impossible to double the power of a station, as there would not be enough water at hand to give double the power. This is especially true in those sections of the country where the power of small streams has been utilized and where the flow of water is continuous but not very great. In addition to a storage battery acting as a receiver for storing the current while the station is not giving a large output, it also maintains, during the operation of the station, a perfectly uniform voltage, which would not be obtained with the varying load direct upon the water-wheels, on account of the difficulty in governing previously mentioned.

When an entirely new power plant is to be built, there is no doubt that by adopting the storage battery in the first instance, the initial cost of installation will be less than for the plant not using storage batteries, and the cost of operation of the station will certainly be very much reduced when the station uses storage batteries. In the case of existing plants which have to be extended, it has been proved that a kilowatt-hour capacity can be added more cheaply to the station by the addition of storage batteries than by the addition of generating machinery; while, of course, the cost of operation is much reduced.

Referring to the primary cost of storage batteries, the cost per kilowatt-hour output is relatively greater for small cells than for large ones, since the cost of manufacture is reduced per kilowatt-hour in the larger sizes, whereas the jars and tanks which are used to hold elements do not decrease very

much with the decrease in size of the elements. The cost of shipment and erection are, of course, slightly less per kilowatt-hour with the larger sizes than with the smaller ones, and on the whole the cost per kilowatt-hour with the larger cells is less than with the smaller sizes. It is stated by the Electric Storage Battery Company that they are now installing large plants of the Tudor type at a cost per kilowatt-hour of about $37 to $40, which cost, it is understood, can be reduced in the larger stations. The question of cost, however, is one which must be studied out in each case where it is proposed to install storage batteries, and a consideration of the cost of installation of storage batteries with their attendant reduction in operating expenses will very soon bring to the mind of purchasers that it is cheaper to invest in accumulators than to invest in additional boilers, engines, and dynamos.

As previously stated, it has been the object of this paper to bring before the Institute the general facts and considerations relating to the installation of storage batteries as auxiliaries to power and lighting plants. Lengthy descriptions of plants already installed have been avoided, and those interested are referred to the published descriptions which are constantly appearing in the technical journals.

THE STORAGE BATTERY OR THE GAS-ENGINE AS AN AUXILIARY.*

By Nelson W. Perry.

Whether it is economical or not to equip a central station with an auxiliary storage battery plant is a question which must be decided separately for each particular installation. Generally speaking, the question will be decided by the character of the load line—a broad topped curve being the most unfavorable, and a sharp peak the most favorable to storage battery economy. Again, a station having a very light day load may use the battery to good advantage even though its night load may present a broad topped aspect.

Aside from purely economic reasons, convenience may be controlling, so that it is impossible to state unless all the conditions are known whether the storage battery is advisable or not.

The price of the battery is an important element, of course, but less so than popularly supposed, for the space which it occupies and the cost of maintenance may largely overbalance any gain in first cost over the cost of the extra boiler, engine, and dynamo.

In regard to the cost of maintenance, manufacturers are willing to guarantee that it will not exceed 10 per cent. per annum, but it is well to understand just what this 10 per cent. means. It means, in the first place, that if you put in all the battery power that the manufacturer recommends, and take care of the battery exactly as he says, then the guarantee holds good. Under such conditions the manufacturer is undoubtedly safe, but if we install a plant under these conditions we are pretty sure to find that the economy in first cost of the battery over engine and dynamo has entirely disappeared.

Then it is well to understand beforehand what the 10 per cent. means—10 per cent. of what? The public are given to believe that this means 10 per cent. of the *cost price* of the batteries and the statement has been freely made that this is what it means.

Some time ago I had occasion to inform myself accurately on this subject, and to this end entered into quite a correspondence with the president of the leading storage battery company of this country. As regards the guarantee, he wrote me under date of June 18, 1894, as follows:

"We send you by to-day's mail our illustrated catalogue, and would especially call your attention to the question of maintenance as contained on page 11. We undertake, in these cases, to provide renewals when renewals are required, at a specific price with a guarantee that this will not be required sufficiently frequent (*sic*) to exceed an average of 10 per cent. per annum. We have every reason to believe from our experience so far that the actual cost of maintenance when the batteries are used at normal rates will not exceed 5 per cent."

Turning to page 11 to see what this meant, I found the following:

"This company is prepared to undertake maintenance contracts according to a scheduled rate of charges, for periods up to 10 years or longer, under which they will guarantee that the total amount paid for renewals during the term of the contract shall not exceed 10 per cent. per annum on the *catalogue* price of the cells specified in the contract. . . . *In all cases of renewal by* contract the old material becomes the property of the company, *and must be returned to their works free of charge for carriage or packing.*"

[The italics are mine.]

Since the regular trade discount at that time was 20 per cent. of the catalogue price, and a further discount was offered which made the cost of the batteries comparable with that of an engine and dynamo, the guarantee assumed a very different aspect from that which it bore on its surface. When to this was added the cost of packing and carriage back to the factory, it ceased to be an attractive guarantee, and my calculations showed that in many cases where the storage battery might be recommended, if the guarantee was what it appeared to be, it would not be economical under the guarantee as it actually was.

This petty deception, together with the application of the battery to uses for which it is not adapted, has brought it into an ill repute from which it will take a long time to recover, and for which the manufacturer has only himself to blame.

As before indicated, there are some situations in which either convenience or extreme steadiness of current may be controlling in deciding the question of the use or not of storage batteries. But where the question is one purely of economy, I would not myself recommend their use under any circumstances, simply because there is a still more economical method at hand. I refer to the gas-engine. Even if it were necessary to use illuminating gas from the street mains it would be more economical (considering space and other factors), to take the peak of the load with a gas-engine than to install a battery for this purpose. In this case there would be no standby losses, and the engine would be ready at a moment's notice to be thrown into service.

It is a fact that has been amply demonstrated by others as well as myself, that a given number of lights can be produced with half the gas burned in a gas-engine that is required to produce them in ordinary burners. The mechanical efficiency of the gas-engine is not quite so high as that of large compound condensing steam-engines, rarely ever exceeding 83 to 85 per cent., while the latter may go to 90 per cent., but the total efficiency from fuel to the pulley of the gas-engine is about double that of the steam-engine—reaching 25 per cent. under favorable conditions, whereas with the steam-engine it rarely equals 12 per cent. So that with the gas-engine operating at anywhere near its full load, there would be a gain in efficiency, instead of a loss of, say, 20 per cent. where the battery was used.

As indicating the performance of a gas-engine using illuminating gas at various loads, I quote the following figures obtained from a test of a 12-H.P. (actual) gas-engine:

Actual H.P. developed.	Gas consumption (cub. ft.) each actual H.P.
12	15
11	15.3
10	15.5
9	16
8	16.5
7	17
6	18
5	19
4	21
3	26
2	30
1	48

These figures are somewhat better than would be obtained in practice, but go to show that the gas-engine compares favorably at light loads with the steam-engine under similar conditions.

Thus far I have spoken only of illuminating gas, but the power may be much more cheaply generated by using a fuel gas.

The cost of producers or generators comes to about $11 per H.P. capacity—considerably less than the cheapest boiler, and an idea of the space required may be gained from a statement of Mr. J. Emerson Dawson, who in estimating for a plant of 400 K.W. capacity says that if the gas plant is all on one level it would occupy a ground space of 27 ft. × 54 ft., but, if necessary, all except the gas holder can be placed under or over the engine-room. His estimate for such a plant is, including erection, foundations, and ash-pit for generators $5,500, or $10.38 per H.P.

These fuel-gas generators can utilize advantageously the poorest grades of fuel, and produce from the better grades of anthracite about 160,000 cub. ft. of gas of a calorific value, equal to one-quarter that of 16 C.P. illuminating gas, per ton of coal.

* Paper read at the American Institute of Electrical Engineers.

As to the standby losses of the gas producers, this has been very carefully determined in a number of cases. As an illustration I will cite a single case—by no means the best on record.

At Openshaw a generator which supplied gas for from 250 to 300 I.H.P. was shut down for 41 hours, and the fuel consumption during this time was but 3.9 lbs. per hour, or about 1 per cent. When we compare this with the standby losses of the steam boiler, which is estimated by Professor Kennedy at 10 per cent. of the total consumption in all the boilers, we see how insignificant it is.

A situation usually considered peculiarly adapted to the storage battery is in subordinate or outlying stations where they are charged during the daytime from the central station and act as centres of supply during the night-time.

But gas can much more economically be distributed to these stations than can the electric current, for Mr. Denny Lane* has shown that with ordinary 16 C.P. gas, 3,000 H.P. can be sent a mile for an expenditure of 1 H.P., or one-thirtieth of 1 per cent. of the power conveyed.

My own calculations show that a 6-in. pipe will deliver 6,000 cub. ft. of gas per hour at a distance of 10,500 ft. under 4 in. of water pressure. If this be 16 C.P. gas, allowing 25 cub. ft. per H.P. hour, this quantity represents 240 H.P.

Cast-iron pipe, 6 in. in diameter, having a thickness of $\frac{1}{4}$ in., weighs 31.9 lbs. per foot. The total weight of this 2 miles (nearly) of pipe will therefore be 334,950 lbs. This would be equivalent in conductivity to about 41,869 lbs. of copper. But 4 miles of copper weighing 41,869 lbs. would be equivalent to about four No. 000 B. & S. wires, which would have a resistance for the 4 miles of 0.325 ohms. If the charging current were transmitted at 220 volts, there would be required a current of 848 ampères; but a wire having a resistance of .325 ohms will only deliver under a pressure of 220 volts $220 \div .325 = 677$ ampères, there would, therefore, be required five No. 000 B. & S. wires to deliver this energy, and the weight of this would be 53,540 lbs.

If the distribution took place at 1,000 volts, the ampères required would be approximately 180. To deliver this at the same distance with a loss of 10 per cent. would require 6,264 lbs. copper, and to deliver it at 1 per cent. loss would require 62,642 lbs., which would cost far more than the pipe and still give less efficient transmission.

I think it would be very easy to prove that he gas-engine with fuel gas would prove a much more economical auxiliary to the central station for taking the peak of the load and the loads amounting to fractions of a unit, than the storage battery, and when we consider the efficiency of transmission of energy in the form of gas, which will permit of the location of the gas generators where land is cheap and fuel easily procured, it seems to me that the plan must commend itself to electrical engineers.

Unfortunately the gas-engine business in this country seems to be in the hands of parties totally incompetent to handle it properly, as every one knows who has ever had occasion to seek information from them.

It is probably not too much to say that every attempt thus far made in this country to adapt the gas-engine to electric lighting has proved a failure. Our own manufacturers either do not know what their engines are capable of doing, or else they are afraid to make public what they will do. I believe there is not a single manufacturer who has a printed price-list, and my own experience, and that of others whom I know, has been that it is impossible to get prices quoted until the manufacturer or his agent has been thoroughly satisfied of the exact purpose for which the quotations are desired. Information of any kind is almost impossible to get; and guarantees of performance, when given, are worthless. To such an extent is this true, that nearly all if not all the recent large orders for gas-engines have gone abroad, where the business is conducted on business principles.

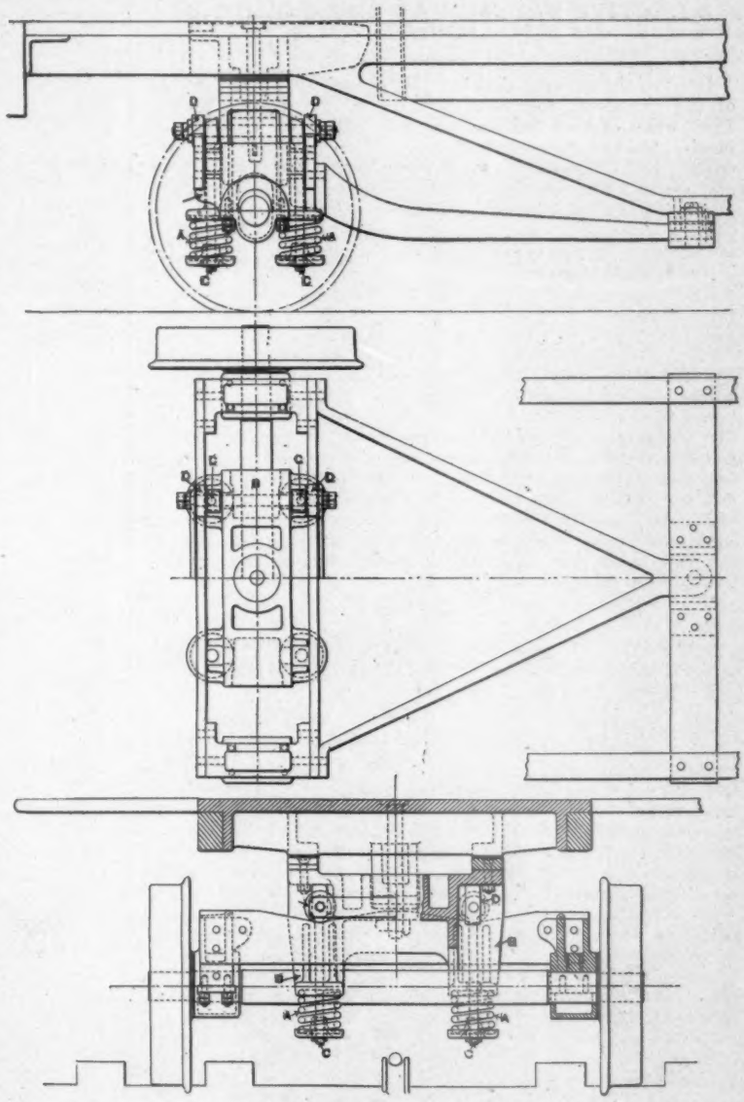
In England, Germany, and France the gas-engine has come into extensive use in isolated lighting, and already has been adopted with satisfactory results in several central stations of considerable size.

When the business is properly handled in this country we may expect to see the gas-engine make its way rapidly in the lighting industry here also, for it has merits which need only be known to be appreciated.

* *Electrician*, October 9, 1891.

PONY TRUCK, BY H. K. PORTER & CO.

In our issue for October we published an illustrated description of the switching locomotives that have recently been built for the New York and Brooklyn Bridge by H. K. Porter & Co., of Pittsburgh, Pa. In this description we referred to the peculiar construction of the pony truck, wherein there are some rollers that, whenever the truck is turned out of alignment, are made to move up an incline and thus maintain a constant tendency to bring the truck back into its central position. We are now enabled to present a detailed drawing of the truck from which a clearer idea of the construction will be obtained than would be possible from a mere verbal description.



PONY TRUCK, MADE BY H. K. PORTER & CO.

The weight of the rear end of the locomotive is put upon the springs *A A* through the casting *B B*. The springs are supported by the hangers *C C* that run down through the centre of the spring and have an eye at the upper end for a bearing on the axle of the sheaves *D D*. When the truck is in its central position these sheaves rest in the bottom of the inclines cut in the truck transom and hold it steadily in place. When the engine is rounding a curve and the wheels turn from the true central alignment the sheaves are caused to roll up the inclines.

In doing this they lift the hangers and exert a pull on the bottom of the springs, not necessarily lifting the engine, but exerting a force whose reaction tends to draw the truck back into position.

In other respects the truck is very simple in construction, and is in reality a mere skeleton. It is interesting to note the arrangement of the parts, which are so disposed as to give the proper clearance for the cable over which they are compelled to run, and which is shown in position between the rails of the end elevation.

A CAPTIVE BALLOON AT THE CHAMPS DE MARS.

DURING the summer that has just passed one of the features of the exposition that was held on the Champs de Mars in Paris was a captive balloon that was built and exploited by Messrs. Godard, Sarcouf & Courty. The balloon had a cubic capacity of 105,950 cub. ft. It was kept inflated for 125 days, and during that period 12,800 passengers were carried, of whom 3,500 were women. At the end of that time a free ascension was made with a load of 15 people.

Referring to our engravings, the smallest (fig. 1) shows the balloon hauled down and fastened to its moorings. Fig. 2 shows the car with its load just as an ascension was about to take place, and fig. 3 is the reproduction of a photograph taken from over the side of the car and looking directly downward. The circle close to the bottom of the picture represents the anchorage of the balloon, and the anchor line is distinctly marked leading from the central pit. This photograph was taken from a height of 1,650 ft., and gives a very good idea of the destruction of perspective by altitude when the line of vision is vertical to the surface of the earth. The roofs of the houses are flattened out so that they seem flush with the ground, and the trees are mere blotches on the surface.

The balloon was controlled by a powerful windlass and cable, the former being driven by steam power and located in the pit beneath the car when the balloon was at its moorings, as shown in the engraving (fig. 2).

DESCRIPTION OF A LOCOMOTIVE DEPOT FOR THE ACCOMMODATION OF 180 ENGINES AND TENDERS.*

By W. G. SCOTT, M. INST. C.E.

THE total area of land comprised within the limits of the site chosen for the above depot is about 90 acres, of which 36 acres are at present being used for the purpose of the locomotive depot requirements, the larger remaining portion of the estate being reserved for future sidings, etc., for dealing with goods and mineral traffic. The whole area of land at present used had to be levelled, and the general nature of the ground peat and sand. The engine shed stands on a site occupying 17,014 sq. yds., is 362 ft. long and 423 ft. wide. It contains 30 lines of rails, each capable of holding six locomotives, giving a total accommodation for 180 engines. In each road is constructed a longitudinal pit used for the purpose of the examination of, and slight repairs to, the machinery of the locomotives. These pits extend the whole length of the shed, with the exception of a distance of 10 ft. at each end, which is left as a passage across the shed. The pits are entered by the men by means of four steps at each end, and are sloping in transverse section at the bottom, the latter being 2 ft. 9 in. below rail level at the lowest point; along one side is placed a cast-iron gutter of U pattern, in section, with wrought-iron perforated covers 12 in. wide. The bottom of the pits are paved with brindle brick on edge, laid on a bed of concrete 4 in. thick; the side walls are built with 18-in. brick-work and faced with brindle brick, each carrying a longitudinal timber covered with sheet-iron 15 I. W. G. to which the rails are secured with screwed spikes, these rails being of Vignole's pattern and weighing 90 lbs. per yard.

The whole of the shed is laid on a foundation formed with Portland cement concrete in the proportion of 6 to 1 and 1 ft. 6 in. thick. The walls are built with common brick, faced with red Ruabon bricks laid in Flemish bond—panelled on the outside and limewashed on the inside, the floor being paved throughout with brindle brick on edge, laid on a bed of concrete.

The roof consists of a series of bays, the principals of which are of the queen post roof truss type, supported by the shed walls outside and on columns inside. The spans of the roofing vary between 41 ft. and 44 ft. with a pitch of about 30°, and having a clear headway of 16 ft. between the underside of the tie beam and the rail.

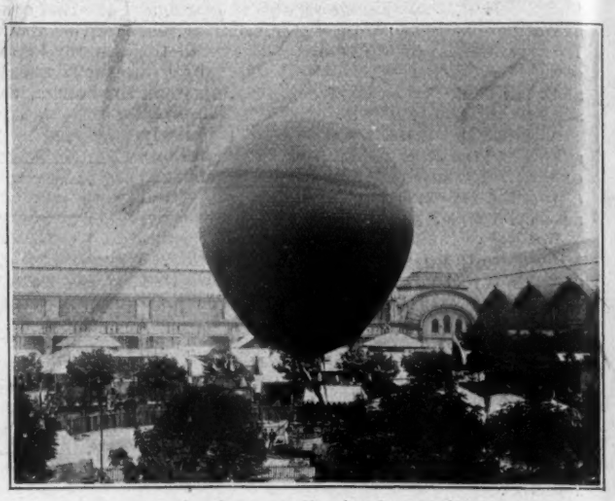


FIG. 1.—CAPTIVE BALLOON AT ITS MOORINGS.

The shed is lighted by day from the roof, by means of skylights, one set running the whole length of the shed on each side of each ridge, and 7 ft. wide, also intermediate lights are placed between the above and the valley gutters, each about 12 ft. × 6 ft. The remaining portion of the roof is covered with Velinhelli slates laid on 1-in. grooved and tongued boarding and spars. The cast-iron columns which carry the roof

FIG. 2.—CAR OF CAPTIVE BALLOON READY FOR AN ASCENT.

principals are 9 in. in diameter, having a base 12 in. in diameter, and are placed at intervals of 24 ft. centres; they are connected with girders of lattice pattern 2 ft. 6 in. × 12 in. Over the centre of each locomotive road, and attached to the underside of the tie beams, is hung a smoke trough measuring 3 ft.

* Paper read before the Liverpool Engineering Society.

6 in. below the tie beam and 3 ft. wide, ventilated at each 24 ft. by means of vertical shafts or flues 2 ft. 8 in. × 1 ft. 3 in., and covered with ¼-in. wrought-iron curved plates supported by angle-irons. These shafts and the troughing carry away the smoke and steam from the locomotives, and at the same time provide perfect ventilation. The whole of the pits are drained into a 12-in. pipe running along and parallel to the front of the shed, this drain being connected to the main outfall sewer by an 18-in. pipe. The entrances to the shed can be closed by means of doors hung to cast-iron jambs, one to each line of rails, built and hung in two halves. In alternate spaces between the locomotive roads are placed, about each 50 ft., hydrants for flushing and washing out purposes, supplied from the water tanks by service pipes 4 in. in diameter.

On each side of the shed are erected two sets of buildings, which are used as a smithy, fitters shop, and mess room, and which are entered from the shed. These two blocks of buildings are each 127 ft. long and 18 ft. wide, the height to the underside of the tie beams being 17 ft. The walls are of 14-in. panelled brick-work.

Each smithy contains several hearths. The mess-room is equipped with table and seating accommodation, also sinks and water supply.

The whole of the shed surrounding buildings and yard are lighted by 2,000 gas jets.

At the east end of the shed, on the outside, are erected two buildings for carrying the water tanks, each 30 ft. high, to the underside of tank, the walls being constructed of 18-in. brick-work, the floor of the inside of this building being paved with brindle brick on edge laid on a bed of concrete. The tanks are constructed of cast-iron plates 6 ft. 3 in. deep by 50 ft. long and 27 ft. 6 in. wide, and will each contain 50,000 galls. of water, being supplied by mains 4 in. in diameter, the inlet being controlled by an equilibrium valve. The tanks are surmounted and surrounded by a handrail 3 ft. high, with a bracketed gallery 2 ft. wide, running entirely round the inside top edge of the tank for the purpose of inspection and repair.

The tanks rest upon cast-iron girders 2 ft. deep, the pressure on the sides is relieved by means of 1-in. raking tie rods in both directions.

Extending across the whole front of the shed and constructed on each road are ash-pits each 33 ft. long, 3 ft. 6 in. deep, with five steps at each end, and are similar in construction to those in the shed. The whole of the area in front of the shed is paved with brindle brick on edge.

Adjacent to these pits, and erected in such a position as to be capable of supplying two roads each, are fixed 10 water columns or cranes which are supplied from the tanks direct by means of 8-in. pipes.

Two sand furnaces are provided. The buildings used for this purpose are each 29 ft. long by 20 ft. wide, and 17 ft. to underside of the tie beam, paved with brindle brick on edge, and containing a furnace used for drying sand, also for lighting the fires of locomotives.

There are also two blocks of buildings used for the purpose of offices, stores and lavatories, each block being 105 ft. long and 27 ft. wide; they are built with 12-in. brick walls with 2-in. cavities, having an internal clear height of 12 ft. The office floors consist of 1¼-in. tongued and grooved boards laid on 7-in. × 2½ in. joists, at 16-in. centres. The stores are paved with brindle bricks on edge, and the floors of the lavatories with concrete.

Two sets of latrines, with accommodation for 15 persons each, and two blocks of water closets are provided.

Three 50 ft. engine turntables are provided. The circular walls surrounding the pits are built in brick-work with Yorkshire stone coping. The centres of the tables are placed on stones 6 ft. 6 in. × 6 ft. 6 in. × 3 ft., laid on a bed of cement concrete resting on sills and supported on 9 in. circular larch piles driven about 18 ft. down into the clay substratum. The movable platform and rails are carried on two iron girders, which are supported upon a centre steel pivot; the girders are connected by ties and trolley castings at each end, and travel on a circular rail path placed in the bottom of the pit.

FIG. 3.—VIEW FROM THE CAPTIVE BALLOON AT THE CHAMPS DE MARS FROM A HEIGHT OF 1,650 FT.

To admit of examinations and light repairs to locomotives, a method of lifting is adopted by means of a hoist, or shear legs; these hoists consist of four wrought-iron uprights, two latticed together; these are fixed at bottom in triangular form on bedstones; the above uprights are in section composed of two channel irons connected by plates; the three uprights are riveted together at the top, and support the tackle for lifting engines; the power is obtained by a winding gear fixed to the lattice supports, and is capable of lifting a load of 35 tons.

To carry out the coaling operations of the engines stabled at this depot there are provided two sheds. Within the sheds are platforms at a height of 11 ft. 6 in. above rail level on either side, and the coal is delivered to the platforms by trucks running up an approach to the sheds at a gradient of 1 in 25. The level at which the coals are thus delivered renders it possible to supply locomotives standing on sidings along each side of the sheds. The length of each shed is 100 ft., and the width of each platform 18 ft. 6 in. The coal is placed on the platforms from the railway wagons standing on the two centre roads of the shed, and is discharged into the tender of the locomotives by tubs on wheels and emptied by means of tumblers or balanced loading-flaps. The length of the inclined approach to the high level is about 250 ft., with a piece of level road 60 ft. in length in front and 60 ft. beyond the end of the coaling shed.

The water supply is derived from the corporation mains, and is conveyed to the depot by means of pipes 6 in. in diameter for a distance of 600 yds.

The permanent way, having a total length of about 7¼ miles, is laid on creosoted sleepers 9 ft. long, 10 in. × 5 in., and is ballasted to an average depth of 18 in. below rail level. The rails are of a bull-head type in 30-ft. lengths, 85 lbs. per yard, and secured to sleepers by chairs spiked and keyed in position.

To connect the engine shed with the main line a double junction with the main line and a branch had to be constructed, also a new signal cabin erected with interlocking apparatus and signals complete.

INGERSOLL DRILLS ON THE CHICAGO DRAINAGE CANAL.

A REPRESENTATIVE of the AMERICAN ENGINEER recently made a visit to Lockport, on the line of the Chicago Drainage Canal, with a representative of the Ingersoll-Sergeant Drill Company for the purpose of inspecting the air compressors and drills at work on Sections 14 and 15, supplied by the Ingersoll Sergeant Company.

Upon Section 14, which is operated by contractors Smith & Eastman, and 1 mile in length, there are two compressors, one 16 × 24 in. straight line, and one 20 × 36 in. duplex Corliss, of 70 H.P. and 330 H.P. respectively.

The air main is of 8-in. wrought iron pipe laid upon the surface, and with occasional offsets to provide for expansion and contraction. This pipe serves 19 drills with air at a pressure of about 80 lbs. per square inch. To prevent the formation of ice at the exhaust openings of the drills, the air is warmed before entering the drills by building a small fire on each side of the service pipe. This also serves, in a slight degree, to restore power lost owing to the cooling and consequent contraction of the air between the compressor and the drill.

Upon this section seven Ingersoll-Sergeant channellers are at work. They are operated by steam, each channeller having its own 30-H.P. vertical boiler. The average work of each channeller for the past season has been about 110 sq. ft. per day of 10 hours. The maximum work, near the surface, 310 sq. ft. In plan the shape of the channelling cutter is a Z about 2 × 6 in. over all.

The average work of the drills is about 82 lineal feet of drill hole, and running from 70 ft. to 100 ft. per day of 10 hours. With these drills and channellers the contractors were enabled to excavate, and they deposited in the spoil bank in a single month 86,000 cub. yds. of solid rock.

The excavated material was transferred to the spoil bank by means of four double boom derricks designed by Mr. Geraldson, the sub-contractor, and by two St. Paul derricks built by the American Hoist & Derrick Company, of St. Paul, Minn.

Upon Section 15 contractors Wright, Meysenburg, Sinclair and Carry, when working a full force of men, employed 10 drills operated by air, and four drills run by steam, as well as three channellers. These, as well as the compressor, were furnished by the Ingersoll-Sergeant Company. The compressor is of the duplex Corliss type 16 × 36 in.

This plant enabled the contractors to excavate 53,000 cub. yds. of solid rock in a single month. The shattered rock is loaded on dump cars by two Bucyrus steam shovels, which handle this rough material in a manner that has to be seen to be realized.

The dump cars are hauled to the spoil bank by locomotives. Mr. Sinclair, one of the contractors, states that nothing short of Swedish iron will stand in the 1-in. and the 1¼ in. chains that operate the motions of the shovels. Steel was tried, but had to be abandoned. The fingers on the buckets are made of charcoal iron tipped with steel. During the past summer there were at work on the line of the Drainage Canal seven Ingersoll-Sergeant air compressors, and located as below:

Section	1, 1	compressor	118 H.P.
"	8, 1	"	330 "
"	12, 2	"	each 150 "
"	14, 1	"	330 "
"	14, 1	"	70 "
"	15, 1	"	207 "

The compressors are thoroughly explained in Catalogue No. 50 of the Ingersoll-Sergeant Drill Company, on pages 30–61 inclusive. One of the main features is the piston inlet for the air, with large valve area and minimum of clearance. The discharge valves only being in the cylinder heads, make it possible to water jacket a major portion of the heads, as well as the body of the cylinder.

The unloading device as a regulator for the pressure is well devised and effective.

The compressors are thoroughly explained in Catalogue No. 50 published by the Ingersoll-Sergeant Drill Company on pages 30-61 inclusive, a copy of which has been received. The various forms of compressors which this company manufacture are very fully illustrated and described in their catalogue, and much interesting and valuable information relating to the subject is given, thus illustrating again the truth of the observation, repeatedly made in these pages, that the best technical literature relating to some subjects is often to be found in trade catalogues. The compressors made by this company may be divided into two general types, the first, which they call their "duplex cross compound condensing Corliss air compressor," and the second, their "straight-line air compressor." The first consists of a two-cylinder compound Corliss engine, the pistons being connected in the usual way to cranks, at right angles to each other, on a main shaft. The rods of these pistons are extended through what on a locomotive would be called the front cylinder-head, and are connected to pistons in air cylinders placed some distance ahead of the steam cylinders. The valve gear is of the Corliss type.

The "straight-line compressor" has a single steam and air cylinder attached to a common frame and placed a short distance apart. The piston rod extends from one cylinder through to the other, and is connected to the two pistons. Midway between the cylinders is a wide cross with bearings on its end, to which a pair of connecting-rods are attached which are coupled to a crank shaft ahead of the steam cylinder. The whole arrangement is very compact and is self-contained. The valve gear of the steam cylinder is of the Meyer type.

The Ingersoll drills and channelling machines are very fully illustrated and described in Catalogue No. 40, referred to above, from which much valuable information may be obtained. We expect to give some illustrations of these machines in a future number.

DEATH OF MR. PATRICK STIRLING.

THE English papers have announced the death of this well-known locomotive superintendent of the Great Northern Railway Company. He was born in Kilmarnock, in June, 1820, and was the son of Rev. R. Stirling, D.D. The son commenced his engineering career by an apprenticeship under his uncle in the Dundee Foundry. After advancing step by step in various positions, he was appointed in 1866 to the position he held at the time of his death. He was noted in that capacity in his own country not only for the ability he showed in the management of his department, but for the fact that he advocated the outside cylinder type of locomotive long after it had been abandoned by most locomotive engineers for express service in England and Scotland. Of this practice *Engineering* says: "The type of locomotive to which Mr. Stirling was loyal to the close was the large single driving-wheel engine, with outside cylinders and a bogie at the leading end." He was a man very much respected by all who knew him, and, as our contemporary says, "his friendship was most valued by those who knew him best."

F. W. DEVOE & CO., (ESTABLISHED 1852.)

Fulton Street, Cor. William, New York.

FURNISHERS OF

Paints, Coach Colors, Fine Varnishes.

According to Specifications, to

Pennsylvania Railroad Company,
New York Central & Hudson River R.R.,
New York, Lake Erie & Western Ry.,
Del., Lack. & Western Ry.,
and others.

Steam Heating from the Locomotive:
Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,199. **SEWALL COUPLERS** sold 55,617; the standard in U. S. and Canada.

Pope Light Compressed Oil Gas:
Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

ALBANY

Electric Heaters for Street Cars:
1,103 Car Equipments sold from Aug. 1 to Dec. 1. West End Boston, People's Traction Philadelphia, Nassau Ry. Brooklyn, Union Ry. Providence and Buffalo Railway have recently ordered over 700 Car Equipments.

CONSOLIDATED CAR-HEATING CO.

Albany, N. Y., 413-423 North Pearl Street:
CHICAGO, 200 WESTERN UNION B'LD'G; Canada, Coaticook, P. Q.—London—Moscow. Specially tested fittings and car lighting repair parts at reasonable prices. Electric Heaters for offices.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.

ESTABLISHED 1824. A SCHOOL OF ENGINEERING. SEND FOR A CATALOGUE.

TRADE VALENTINES MARK.

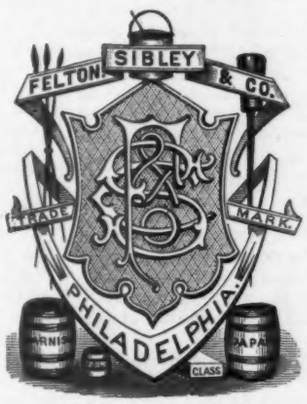
VALENTINE & COMPANY,

MANUFACTURERS OF HIGH GRADE

Coach and Railway Varnishes and Colors,

57 BROADWAY, NEW YORK.

Wabash Ave., CHICAGO. *164 Purchase St., BOSTON.* *21 Rue de Lappe, PARIS.*



SUPERFINE COACH and CAR COLORS in Oil and Gold Size Japan.

HIGH GRADE VARNISHES and UNSURPASSED DRYING JAPANS

Smokestack Black

A SPECIALTY.

FELTON, SIBLEY & CO.,

PHILADELPHIA, PA.

"C" Vernier-Calipers, etc.

ANY GRADUATION.

(METRIC SYSTEM)

Warranted accurate. Highly endorsed and *worth* your *consideration.* My prices are right. Send for Catalogue F.

E. G. SMITH, Columbia, Pa.

RUE "1889" "LITTLE GIANT" INJECTOR Mfg. Co., PHILA., PA.

Facts Worth-Knowing ABOUT Pressure Regulators (Reducing Valves)

For Railroad, Steamship, and other Service.

44-page Hand-Book mailed free.

FOSTER ENGINEERING CO., NEWARK, N. J.

THE AMERICAN BALL PULVERIZER.

SPECIALTIES:

Am. Crusher and Am. Ball Pulverizer.

The Simplest, Cheapest and Best Machines in the Market. Pulverize wet or dry to any degree of fineness. Makes little or no slimes in wet nor dust in dry work. Four sizes, capacity from 2 to 60 tons per day.

SEND FOR CATALOGUE.

Cable Address, American.

First Prize and Gold Medal Awarded by World's Fair, 1893.

THE American Mining & Milling Machinery Co.

29 Euclid Ave., CLEVELAND, O. 280 Caxton Block, CHICAGO, ILL.

Office of THE CLEVELAND IRON ORE PAINT CO. and THE GARRY IRON ROOFING CO.,
CLEVELAND, O., Jan. 25, 1894.

The American Mining and Milling Machinery Co., Cleveland, O.:

GENTLEMEN: We purchased a No. 2 American Rock Breaker and a No. 2 American Ball Pulverizer from your company about one year ago. The latter part of April, 1893, we started up for regular work, since which time we have run both of said machines to the full extent of our demands and to our entire satisfaction. The first 700 tons of hard iron ore that we pulverized for paint purposes was ground without taking the Pulverizer apart, and without expending one dollar for repairs for either of these machines. Of the 700 tons spoken of, about 200 tons was Lake Superior Specular Iron Ore, containing some 70 per cent. iron; a very difficult ore to pulverize. The remainder was a red fossiliferous iron ore, carrying quite a per cent. of silex, which cuts out buhr stones rapidly. We find that the steel balls, which were when new 5 in. in diameter, now caliper 4⅛ in., and are perfectly round and smooth. The grinding track shows very little wear, and the driving track shows less; in fact the wear is almost imperceptible. These two machines crush and pulverize more than one ton per hour with less than 12 H.P. We do not know of any Crusher or Pulverizer that can compare with the output of these two machines in quantity, quality, small amount of wear and tear, and like power. In our opinion you cannot recommend them too highly.

Very truly yours, CLEVELAND IRON ORE PAINT CO.

AMERICAN ENGINEER AND RAILROAD JOURNAL.
(Formerly the RAILROAD AND ENGINEERING JOURNAL.)

PUBLISHERS' DEPARTMENT.

General Notes.

Mr. L. M. Moyes, the patentee and manufacturer of the Combine Safety Water-Tube Boiler, has entered suit, through his attorneys, Messrs. Biddle & Ward, of Philadelphia, against the Stirling Boiler Company, of Barberton, O.

The Edward P. Allis Company, of Milwaukee, Wis., ha been awarded the contract with the Carnegie Steel Company, of Pittsburgh, for building seven verticle duplex compound condensing blowing engines with 40 × 60 high-pressure, 78 × 60 low-pressure, and 76 × 60 blowing cylinders for their Duquesne steel plant.

The Union Bridge Company, of No. 1 Broadway, New York, consisting of Charles Macdonald, of the city of New York; Charles S. Maurice, of Athens, Pa., and Edmund Hayes, of Buffalo, N. Y., begs to announce that Charles S. Maurice and Edmund S. Hayes have retired from the firm, and the partnership is hereby dissolved. Existing engagements will be executed in accordance with agreement, and any one of the partners is authorized to sign in liquidation. The good will of the business is transferred to a new firm, of the same name, consisting of Charles Macdonald and Andrew Onderdonk.

The Prentiss Tool & Supply Company, with principal headquarters at 115 Liberty Street, New York City, have recently removed their Chicago branch from No. 59 to 62 and 64 South Canal Street.

The new quarters are finely located and equipped with every essential for the convenient and efficient handling of the large business done by the Prentiss Company at this point. The show-room and offices occupy a floor space of 40 × 140 ft., and a complete line of new and second-hand machinery of the latest and most improved design will be carried at all times. Those visiting it will find the new Chicago branch of the Prentiss Tool & Supply Company to be one of the finest machinery stores in the West.

Honors to W. W. Snow.—The good wishes of his friends were projected eastward when Mr. Snow recently sailed for Europe to attend the Railway Congress. He was invited to do so by Mr. Henry S. Haines, President of the American Railway Association, as representative of the manufacturers of railway appliances in this country.

Mr. Snow has also been appointed by Governor Morton one of five commissioners to represent the State of New York at the Cotton States Exposition, to be held at Atlanta from September 18 to December 30. The following ladies have also been named to act with the commissioners: Mrs. Levi P. Morton and Mrs. James E. Graybill, of Albany; Mrs. Henry B. Plant, Mrs. A. Howard Townsend and Mrs. Donald McLean, of New York.

As the congress is to be opened by the Prince of Wales and received by the Queen at Windsor Castle, Mr. Snow may have an English accent when he returns to this country.

The Mexican Exhibit at Atlanta.—Notice has been received at the headquarters of the Cotton States and International Exposition from the Secretary of Promotion of the Mexican Government that the plans for the Mexican exhibit at Atlanta have been completed, and asking that a very large amount of space be set aside for that purpose. The Mexican exhibit, which has been vigorously promoted by President Diaz and other leading men in Mexican public life, will be very fine. One of the features of the Mexican representation will be the famous Eighth Regiment military band, which won such fame at the New Orleans Cotton Exposition of 1884. The Mexican village, which will also be part of the Mexican representation at the Fair, will cover nearly three acres, and will be an elaborate and picturesque presentation of Mexican life.

The Detrick & Harvey Machine Company, of Baltimore, Md., have just received an order from the Watertown Arsenal, Watertown, Mass., for an open-side extension planer, which, when completed, will be one of the largest in the country. This tool is to be an exact duplicate of one which has been in operation at the arsenal for about two years. It will plane 96 in. high, 132 in. wide, and 24 ft. long, and will weigh about 150,000 lbs. The large post of this planer is 13½ ft. high, 7 ft. 3½ in. wide, and 2 ft. 8½ in. thick. A very good idea as to the possibilities and capacity of the open-side planer can be formed when it is known that this single piece, weighing about 20,000 lbs., was planed all over on a 42 in. open-side planer. It is a strong argument in favor of the rigidity, durability, and efficiency of the open side, that one of the best-conducted machine shops in this country, after a careful but severe test of the merits of this tool for heavy work, should see fit to place an order with this well-known firm for another tool of such size.

Henry L. Leach has sent us a list of purchasers to whom he has sent his pneumatic sanding apparatus. The list includes a total of 83 sets, of which 49 went to locomotive builders, and is as follows: Pennsylvania Railroad, 6; Chicago & Alton Railroad, 1; Richmond for Seaboard Air Line, 2; Schenectady for Southern Pacific, 9; Richmond for Southern Railway, 6; Richmond for Seaboard Air Line, 6; Memphis & Charleston, 1; Pittsburg for Duluth, Missouri & Northern, 1; Delaware, Lackawanna & Western, 2; Schenectady for Fitchburg Railroad, 3; Baldwin's for Buffalo & Susquehanna, 4; Baldwin's for Western Maryland, 1; Delaware, Lackawanna & Western, 6; Southern Railway, 1; New York, Lake Erie & Western, 1; St. Clair Tunnel Railway, 8; Chicago, Burlington & Quincy Railroad, 1; Southern Railway, 1; Dicksons for New York, Ontario & Western, 1; New York, Ontario & Western, 1; Schenectady for (?), 2; Cooke's for Southern Pacific Railway, 4; Schenectady for Fitchburg Railroad, 2; Schenectady for Southern Pacific Railway, 3; Beech Creek Railroad, 5; Schenectady for General Electric, 2; Schenectady for Chicago & Northwestern, 2; Baldwin's for Western Railroad of Alabama, 1.

Explosion of a Water-tube Boiler.—The steamer *Unique* is a vessel engaged in fast passenger service between Detroit and Port Huron. She was recently fitted with Babcock & Wilcox boilers, and has quadruple-expansion engines. The *Marine Review* reports that she left Detroit on May 13 on one of her regular trips, and when about 2 miles above the lightship in Lake St. Clair, a 3-in. water-tube on the port side of the furnace in the forward boiler burst. One fireman was in the bunker passing coal, and was probably killed instantly; another was passing into the engine-room at the time, and was so badly scalded that death resulted later. The Chief Engineer, T. M. Robinson, was on deck at the time, standing at the forward gangway on the port side, and, probably from the concussion, lost his balance and fell overboard and was drowned. His death is the saddest feature of the whole history of the boat. He was a fine fellow, beloved by all who knew him. He was six years on the *Majestic*, and was among the best engineers on the lakes. Engines and boilers had both been doing good work in the *Unique*, and the boat was beginning to realize a profitable business. The boilers had proven themselves capable of doing what was claimed for them, but with all the care that was evidently used in their construction this defective tube escaped detection.

Baltimore & Ohio Electrical Motor.—One of the electric locomotives for the Baltimore & Ohio's Belt Railroad has been received in Baltimore.

This locomotive is one of three to be supplied by the General Electric Company, of Schenectady, N. Y., for the Belt Railroad. Three or four days will be required to assemble its various parts, after which a trip will be made with it through the tunnel.

The motive power for the locomotive is furnished by two six-pole axle-motors to each truck. These motors are flexibly supported and transmit their power to the wheels by means of flexible connections. The locomotive has a sheet-iron cab, which will be occupied by the person in charge, with windows on all sides, so that an unobstructed view may be obtained. The motors are easy of access, and can be readily gotten at under all circumstances, whether running or standing still. The locomotive is equipped with a serious parallel controller, electric air-pump, air-brakes, air-whistles, bell, and safety devices. It also has the Janney automatic coupler at each end. It is designed to run in either direction equally well.

Following are some of the principal characteristics of this piece of mechanism: Weight, 96 tons and 600 lbs.; length over all, 34 ft. 8 in.; height over all, 14 ft. 3 in.; maximum speed, 50 miles an hour; drawbar pull, 56,000 lbs.; extreme width, 9 ft. 6¼ in.; wheel-case of each truck, 6 ft. 10 in.; wheel-base of each truck, 6 ft. 10 in.; diameter of driving-wheels, 62 in.; number of driving-wheels, 8, with cast-steel centres and steel tires; size of journal, 6 × 8½ in.; gauge,

BOOKS FOR ENGINEERS AND MECHANICS.

The number of books, pamphlets and periodicals on engineering and mechanical subjects in existence, and which is published annually, is now so large that no engineer, mechanic or railroad employee can hope to read more than a very small fraction of them, and it is of the utmost importance that such persons should read only the best. Besides the really valuable books which are written by competent persons, who are experts in the subjects about which they have written, there is every year a large number of poor ones published which are written by more or less conceited or stupid incompetents, or by those whose only motive in writing is to make their names known, and such books it is, to a great extent, a waste of time to read and a waste of money to buy. This, as some one has written, "makes it extremely difficult for engineers, mechanics and railroad employees, anxious to keep themselves informed about their business, to know what it is really worth their while to read. They cannot read all that appears, for lack of time, and much of it is not worth reading; yet in the absence of capable criticisms of such works, they cannot easily learn what is really good."

These considerations, and the letters which an editor constantly receives enquiring about books and asking for information about them, has led me to conclude that it might be beneficial to many persons, especially to mechanics and others, whose information concerning the literature relating to their occupations is somewhat limited, and that it would be perfectly proper to recommend certain books which deserve recommendation, and give some information about their value and character. With this in view, the following notices of books have been prepared, and their value and character have been as well indicated as has been possible in such brief descriptions as are here given. These notices represent my own estimate of the character and value of the books to which they refer, and none will be noticed in this list, excepting those which can be recommended to readers, although it may be with some qualifications, as it is seldom that either books or people are altogether good. M. N. FORNEY.

The Steam Engine.

By GEORGE C. V. HOLMES. 5×7 in. 528 pp. Price, $2.00.

Is a more complete treatise on the steam engine than Ripper's book, and is also of recent date, and well up to modern practice. It is perhaps the best book on the general subject of the steam engine that a student, mechanic or young engineer can read. It is not very elaborately illustrated, but has 212 excellent wood cuts. It contains no mathematics more difficult than algebra, and not much of that. The science of heat and steam is treated in the earlier chapters, the theory of the steam engine follows. These are succeeded by descriptions of the mechanism of engines and boilers, and the concluding chapters are on compound engines. It does not relate especially to stationary, locomotive or marine engines, but the principles and construction of all these are discussed.

A Hand-Book of the Steam Engine.

By HERMAN HAEDER, C. E. 440 pp. 4¾×7 in. Price, $3.00.

The title page of this book—which is translated from the German—says that it has especial reference to small and medium-sized engines for the use of engine makers, mechanical draughtsmen, engineering students, and users of steam power. It is illustrated by over a thousand engravings showing the construction of stationary engines and their details. The general plan of the book is to show the construction of the engines and their parts by engravings and brief descriptions. Its defect is that the descriptions are often not full enough, and do not make the subject to which they relate entirely clear. The engines illustrated are chiefly of German construction, and for that reason, will have very great interest to American mechanics. The book contains little about the theory of the steam engine, and the only mathematics in it, are constructional calculations, and some algebra, but the latter is of a very simple kind, and there is not much of that. In studying the details of construction of small steam engines, this book will be an excellent aid, notwithstanding the defect referred to.

The Catechism of the Locomotive.

By M. N. FORNEY. Second Edition. 709 pages 6×8 in., and six folded plates. Price, $3 50.

As its name implies, this book is written in the form of questions and answers, and as one of its reviewers said "is written on a low plane;" that is, the subjects to which it relates are explained in the simplest and clearest language that the author could command. As stated in the preface, his object in writing the book "was to furnish a clear and easily understood description of the principles, construction, and operation of the locomotive engine of the present day." There are but two mathematical elucidations in it, and they are in foot notes. It contains nearly 500 engravings which illustrate very fully, different classes of American locomotives and the construction of their parts. The principles and practice involved in these and in the operation of the whole machines are very fully explained, the aim being to make it "plain to plain people." At the same time, the subject was brought fully up to the practice which prevailed when this edition was first brought out, which was in 1889. The book is suited for engineers, mechanics, firemen, students, and, in short, any one who wants information about the principles and construction of the locomotive of the present day.

Compound Locomotives.

By PROF. ARTHUR TANNATT WOODS. Second edition revised and enlarged by David Leonard Barnes. 330 pp. 5¾×8¾ in. 166 engravings. Price, $3.00.

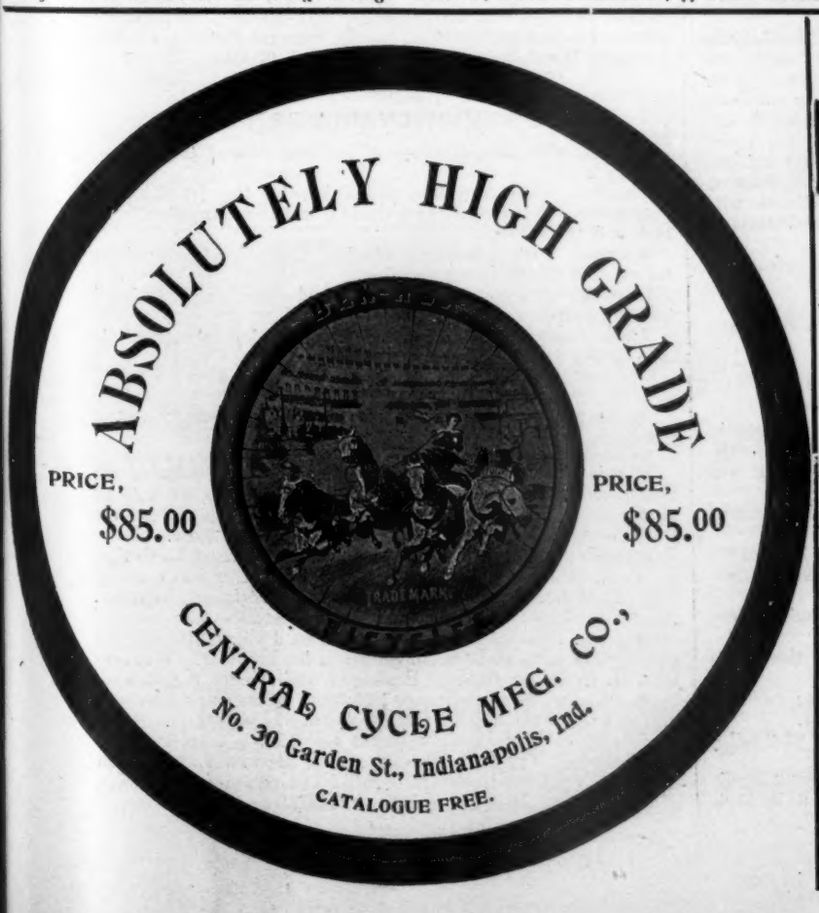
The purpose of this book is to give a description of the theory and construction of the Compound Locomotive in its most recent forms. This is admirably done and in a form so clear that it can be readily understood by any one at all acquainted with the subject of locomotive engineering. It is not an elementary book on the locomotive, but an explanation of compound locomotives for those who are acquainted with the principles and details of simple engines.

The Construction of the Modern Locomotive.

By GEORGE HUGHES. 261 pp. 5¼×8¼ in. 309 Figs 3 folded plates. Price, $3.50.

As its title indicates, and as the author says, "design is not touched upon" in what he has written. "Each section," he says, "describes, step by step, more minutely, and by such drawings and illustrations as have not appeared before in one volume, the actual progress of the work done in that station." The author is an Englishman and describes how an English locomotive is built, or how the work is done in the boiler-shop, iron and brass foundries, the forge and "smithy," coppersmith's work, machine and erecting shops. The methods of doing work is illustrated by engravings from original drawings. American readers will be interested in some of the methods in use in British shops, which differ somewhat from American practice. The book is a good one, but considering what an excellent subject the author had, what he has written and published ought to have been better than it is.

Any of the above books will be sent, prepaid, on receipt of the price, or information will be given, on application, with reference to the character and value of other books on mechanical engineering. Address, M. N. FORNEY, 47 Cedar Street, New York



SOME SPECIAL FEATURES
OF THE
AMERICAN ENGINEER
AND
RAILROAD JOURNAL.
FOR THE PAST SIX MONTHS.

JANUARY, The Shops of the Flint and Père Marquette Railroad Superintendent's Engine on the Lehigh Valley Railroad; Early American Locomotives Built in England; The Application of Water Tube Boilers to War Vessels; An Experimental Study of the Effect of the Counterbalance in Locomotive Driving Wheels; The Method of Determining Chloride in Ammonium Chloride.

FEBRUARY, Water-Tube Boilers and their application to War Vessels; Fuel Consumption by Locomotives; Early Days of the Iron Manufacture; The History of the Four-Wheeled Bogie Locomotive; Bork's Brick-Lined Locomotive Firebox.

MARCH, The United States Armored Cruiser "Maine;" The Joy Valve Gear; Possible Sources of Locomotive Fuel Economy; A Mast Traveler for Erecting Heavy Work.

APRIL, Some Facts Relating to Certain Types of Water-Tube Boilers Wrecking Crane, Philadelphia & Reading R. R.; The Cruiser "Cincinnati;" Tests of the Pneumatic Guns; Rapid Transit in Large Cities; The Electric Motor in a Boiler Shop; The Deterioration of Locomotive and Marine Boilers Due to Expansion and the Means of Lessening the same; The Narrow Guage Delusion.

MAY, Method of Determining the Flashing and Burning Points of Combustible Liquids; Electric Motors at the Southwark Foundry & Machine Co.'s Shops; Sand Shed at Hornellsville, New York, Lake Erie and Western Railroad; The Gas Engine; Water-Tube Boilers in the British Navy; Cylinder for Class P Locomotive, Pennsylvania Railroad.

JUNE, Method of Determining Tar and Tar Acids in Wood Preservatives; Coal Storage Plant at Port Richmond; Some Facts Relating to Certain Types of Water-Tube Boilers; Scale Testing Car Philadelphia & Reading R.R.; The Efficiency of the Compound Locomotive; Water-Jet Pile Driving.

BACK NUMBERS MAY BE PROCURED AT 25 CENTS EACH.

Address M. N. FORNEY,
47 Cedar Street, New York.

4 ft. 8½ in.: voltage, 500; maximum full drawbar pull, 15 miles an hour; maximum half drawbar pull, 30 miles an hour; ampère at maximum drawbar pull, and 15 miles an hour, 2,700. The motors are wound for 250 volts, and are to be run two in series.

It is proposed after completing all arrangements for regularly running the electric locomotives through the tunnel to have a formal opening, to which President Cleveland, the diplomatic corps, and other distinguished persons are to be invited.

Graphite Paint.—Twenty-five or thirty years ago the Dixon Company, of Jersey City, N. J., who even at that time were known the world over as the largest manufacturers of graphite products, began the manufacture and introduction of graphite paint. Ticonderoga flake graphite was used and thoroughly ground in pure, boiled linseed oil. Roofs well painted with this paint did not require repainting for ten to fifteen or even twenty years. In time all this became a matter of record, and people recognizing the economy as well as the durability of Dixon's graphite paint and its great superiority over mineral paints, demanded that their roofs should be painted with it. This demand, however, has led many painters to resort to sharp practices, or to make a graphite paint which they claim to be equal to Dixon's. Some painters are unprincipled enough to offer as graphite paint a compound having the color of graphite, but composed of stove-polish, cheap black lead, or even foundry facings, mixed with oil. Other painters, honest in their intentions, but ignorant that there is a vast difference in graphite, have used ordinary commercial black lead, ground with oil, expecting it would meet the requirements of their customers and prove lasting as the genuine Dixon graphite paint. So wide, however, is the difference in results, that experienced buyers insist on seeing the label on the package, or buy the paint themselves and have the painter apply it. Some time ago one of the departments of the United States Navy ordered 100 lbs. of Dixon's graphite paint of a well-known dealer. The dealer, not having that quantity on hand in an original package, filled a keg from a barrel of Dixon's paint and sent it forward. It was promptly returned by the Government officials with the remark, that they had experimented enough with other makes and would only receive original packages.

An experience covering a quarter of a century and over has demonstrated that the peculiar flake graphite, mined at Ticonderoga, gives the best results. When the paint is brushed out each flake laps over its fellows, after the manner of fine fish scales, forming a covering of great elasticity and durability.

Run of the Special Newspaper Train from Philadelphia to Atlantic City.—On Sunday morning, April 21, the special train carrying the morning papers from Philadelphia to Atlantic City made an exceptionally fast run. The train consisted of one combined passenger and baggage car No. 5,116, and Pennsylvania Railroad Class "P" locomotive No. 1,658. This locomotive and car were taken out of regular service, not in any way having been specially prepared for fast movement. The locomotive ran the 4.10 P.M. train to Atlantic City on Saturday afternoon and was returned to Camden Saturday night for this special movement.

The principal dimensions of locomotive 1,658 are as follows:

Number of pairs of driving-wheels, 2.
Diameter of driving-wheels, 78 in.
Diameter of cylinders, 19 in.
Length of stroke, 24 in.
Pressure of steam per square inch, 175 lbs.
Weight of locomotive in working order, 122,600 lbs.
Fuel used, bituminous coal.

The boat connecting with this train left Philadelphia exactly at 5.30 A.M. Newspapers were transported on it in an ordinary baggage truck. On arrival at Camden the truck was hauled to car and newspapers transferred.

The train left Camden Station at 5.35¼ A.M, and arrived at Atlantic City at 6.21¼ A.M.

Running time from Camden to Atlantic City, 45¾ minutes; distance, Camden to Atlantic City, 58.3 miles; average speed, 76¼ miles per hour.

From Liberty Park to Absecon, 49.8 miles; running time, 37½ minutes. Average speed, 79.7 miles per hour.

From Berlin to Absecon, 35.6 miles; running time, 25¾ minutes. Average speed, 82.9 miles per hour.

From Winslow Junction to Absecon, 24.9 miles; running time, 16 minutes. Average speed, 83 miles per hour.

Fastest mile, 41 seconds—equivalent to a speed of 87.8 miles per hour.

The eminent success of this speed test reflects great credit on the management which has brought this line up to its high standard of excellence. The maintenance of the roadbed in the best possible condition, and a very high grade of equipment, are features which receive the highest consideration. Very few, if any, branch lines in the country can show so fine a physical condition as the sea-shore lines of the Pennsylvania system.

Messrs. Cramp & Sons in the Stationary Engine Field.—An important combination of engine manufacturing interests has just been effected which will have a decided and immediate influence upon the business. In the American Wheelock Engine Company will be brought together the long and valuable experience of some of the best known American engine builders—Messrs. William Cramp & Sons, of Philadelphia; Hoadley Brothers, of Chicago, the patentees of the Greene engine, of Providence, and of the Wheelock engine, of Worcester. The President of the new company is Edwin S. Cramp; the Vice-President, Alfred H. Hoadley; the Secretary and Treasurer, Joseph H. Hoadley; the General Manager, Edward K. Hill. The new company will manufacture the Greene-Wheelock engine, with Hill valve gear, under the patents of Messrs. Wheelock, Greene, Hill, and Hoadley, all of which have been purchased, together with the Wheelock plant, at Worcester. Much of the work, particularly the marine engines, will, however, be carried on at the immense Cramp works at Philadelphia. At the latter place new additions are being made for this branch of the business, besides which the regular facilities in all other departments will be available. Joseph H. Hoadley will be one of the most active workers for the new company in the field, and, it is needless to say, will secure important contracts. In fact, he has already taken one of the largest orders given in the East this spring, that of the engine equipment for the new station of the Edison Illuminating Company, of Boston, which will use Greene-Wheelock engines with Hill valve gear, and the Rockwood compound system in 1,600 H.P. units. These will be placed beside triple-expansion engines, and are expected to show a better economy than the latter for this class of work. It is interesting to note that Government methods have been introduced in this particular contract, the purchaser agreeing to pay a bonus of $2 for each half pound of steam per H.P. hour saved over the maker's guarantee.—*Street Railway Journal.*

MAP OF THE UNITED STATES.

A LARGE, handsome map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of 15 cents in postage by P. S. Eustis, General Passenger Agent, Chicago, Burlington & Quincy Railroad, Chicago, Ill.

THE PENNSYLVANIA RAILROAD

is favored with the patronage of the best class of travelers.

Why?

Because, with complete protection by the block-signal, automatic and interlocking switches, and an unsurpassed roadbed, it is the safest.

Because, with a superb service of perfectly appointed trains, it is the most comfortable.

Because, with wise management and unlimited facilities, it is the promptest.

These reasons are heavy, and they tip the balance on the side of the "standard railway of America."

"BODY RESTED, MIND AT EASE."

That is what it is when travelling on the fast trains of the Chicago, Milwaukee & St. Paul Railway; besides there is no chance to "kick," for the accommodations are up to date, the trains keep moving right along and get there on time. These lines thoroughly cover the territory between Chicago, La Crosse, St. Paul, Minneapolis, Aberdeen, Mitchell, Sioux Falls, Sioux City, Yankton, Council Bluffs, Omaha and Northern Michigan. All the principal cities and towns in that territory are reached by the "St. Paul" lines, connecting at St. Paul, Council Bluffs and Omaha with all lines for points in the far west. Write to Geo. H. Heafford, General Passenger and Ticket Agent, Chicago, Ill., for one of their new map time tables and a brochure giving a description of the Compartment Sleeping Cars. Tickets furnished by any coupon ticket agent in the United States and Canada. The finest dining cars in the world are run on the solid vestibuled, electric-lighted and steam-heated trains of the Chicago, Milwaukee & St. Paul Railway.

F. W. DEVOE & CO., (ESTABLISHED 1852.)

Fulton Street, Cor. William, New York.

FURNISHERS OF

Paints, Coach Colors, Fine Varnishes.

According to Specifications, to

Pennsylvania Railroad Company,
New York Central & Hudson River R.R.,
New York, Lake Erie & Western Ry.,
Del., Lack. & Western Ry.,
and others.

Steam Heating from the Locomotive:
Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,199. **SEWALL COUPLERS** sold 55,617; the standard in U. S. and Canada.

Electric Heaters for Street Cars:
1,103 Car Equipments sold from Aug. 1 to Dec. 1. West End Boston, People's Traction Philadelphia, Nassau Ry. Brooklyn, Union Ry. Providence and Buffalo Railway have recently ordered over 700 Car Equipments.

CONSOLIDATED CAR-HEATING CO.

ALBANY

Pope Light Compressed Oil Gas:
Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

Albany, N. Y., 413-423 North Pearl Street:
CHICAGO, 200 WESTERN UNION B'LD'G; Canada, Coaticook, P. Q.—London—Moscow. Specially tested fittings and car lighting repair parts at reasonable prices. Electric Heaters for offices.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.

ESTABLISHED 1824. A SCHOOL OF ENGINEERING. SEND FOR A CATALOGUE.

TRADE VALENTINES MARK.

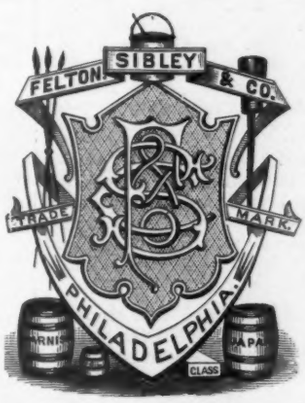
VALENTINE & COMPANY,

MANUFACTURERS OF HIGH GRADE

Coach and Railway Varnishes and Colors,

57 BROADWAY, NEW YORK.

390 Wabash Ave., CHICAGO. *164 Purchase St., BOSTON.* *21 Rue de Lappe, PARIS.*



Non-Corrosive Priming and Finishing Paint

For Engines, Machinery, etc.

This paint being entirely free from acid, will not corrode or rust the iron.

Patent Iron Filler

For Tools, Machinery, Engines, Locomotives, Tenders, Iron Ships, and all Iron Work for Buildings, inside or out.

Pure Oxide Paints

For Bridges and General Construction Work.

Send for sample cards and prices.

FELTON, SIBLEY & CO.,
Philadelphia, Pa.

PRESSES, DIES, AND OTHER
SHEET-METAL TOOLS
FERRACUTE MACHINE CO. BRIDGETON N.J. U.S.A.

RUE "1889" "LITTLE GIANT" INJECTOR
Mfg. Co., PHILA., PA.

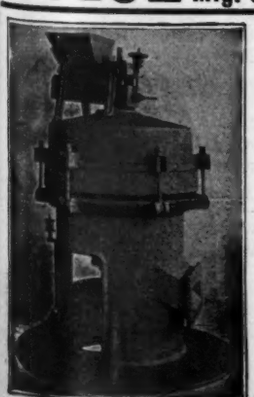
Facts Worth-Knowing ABOUT Pressure Regulators

For Railroad, Steamship, and other Service.

(Reducing Valves)

44-page Hand-Book mailed free.

FOSTER ENGINEERING CO.,
NEWARK, N. J.



THE AMERICAN BALL PULVERIZER.

SPECIALTIES:

Am. Crusher and Am. Ball Pulverizer.

The Simplest, Cheapest and Best Machines in the Market. Pulverize wet or dry to any degree of fineness. Makes little or no slimes in wet nor dust in dry work. Four sizes, capacity from 2 to 60 tons per day.

SEND FOR CATALOGUE.

Cable Address, American.

First Prize and Gold Medal Awarded by World's Fair, 1893.

THE American Mining & Milling Machinery Co.

29 Euclid Ave., CLEVELAND, O. 280 Caxton Block, CHICAGO, ILL.

Office of THE CLEVELAND IRON ORE PAINT CO. and THE GARBY IRON ROOFING CO.,
CLEVELAND, O., Jan. 25, 1894.

The American Mining and Milling Machinery Co., Cleveland, O.:

GENTLEMEN: We purchased a No. 2 American Rock Breaker and a No. 2 American Ball Pulverizer from your company about one year ago. The latter part of April, 1893, we started up for regular work, since which time we have run both of said machines to the full extent of our demands and to our entire satisfaction. The first 700 tons of hard iron ore that we pulverized for paint purposes was ground without taking the Pulverizer apart, and without expending one dollar for repairs for either of these machines. Of the 700 tons spoken of, about 200 tons was Lake Superior Specular Iron Ore, containing some 70 per cent. iron; a very difficult ore to pulverize. The remainder was a red fossiliferous iron ore, carrying quite a per cent. of silex, which cuts out buhr stones rapidly. We find that the steel balls, which were when new 5 in. in diameter, now caliper 4⅞ in., and are perfectly round and smooth. The grinding track shows very little wear, and the driving track shows less; in fact the wear is almost imperceptible. These two machines crush and pulverize more than one ton per hour with less than 12 H.P. We do not know of any Crusher or Pulverizer that can compare with the output of these two machines in quantity, quality, small amount of wear and tear, and like power. In our opinion you cannot recommend them too highly.

Very truly yours, CLEVELAND IRON ORE PAINT CO.

AMERICAN ENGINEER AND RAILROAD JOURNAL.
(Formerly the RAILROAD AND ENGINEERING JOURNAL.)

PUBLISHERS' DEPARTMENT.

General Notes.

Bement, Miles & Co. have opened an office at 1534 Marquette Building, Chicago, and have appointed Mr. Charles E. Billin as their representative.

The National Water-Tube Boiler Company, of New Brunswick, N. J., have recently appointed Mr. Frederick E. Bruce, late Manager of the Stirling Company of Cleveland, O., to take charge of their New York office, which is at 74 Cortlandt Street.

The McSherry Manufacturing Company, of Middletown, O., have recently sold their lifting-jack business to E. C. Boyer, of Dayton, O., who was a former Secretary of the Company, and who is familiar with the business and will give it his personal attention.

The Rice & Sargent Engine Company, of Providence R. I., has received an order for a vertical engine 28 and 60 × 48, 1,800 H.P., 100 revolutions, 150 lbs. steam, with pulley fly-wheels adapted for a rope drive, and also a standard engine 12 × 30, 75 H.P., 110 revolutions, for the Whitman Mills, New Bedford, Mass.

W. A. Crook & Brothers Company, Newark, N. J., builders of high grade hoisting machinery, recently received from New Orleans an order for three large log skidders, which will be used in the cypress district near Raceland, La. The order came through the C. S. Burt Company, who are the representatives of the W. A. Crook & Brothers Company in that section.

The Nicholson File Company, of Providence, R. I., whose output is a large percentage of the entire file product of this country, have caused to be posted in their three factories, two at Providence, R. I., and one at Pawtucket, R. I., notices announcing a material advance in wages paid their employés. This increase will affect upward of 1,000 hands, and on the part of this company was a purely voluntary act.

The Cleveland Twist Drill Company have just shipped three of each size of their grip sockets to the Norfolk Navy Yard. This is the third Navy Yard that has been equipped with these grip sockets which the Cleveland Twist Drill Company have lately introduced to the market. Many of the largest manufacturers throughout the country have adopted them for their works, and the company are hard pushed to keep up with their orders.

A Mexican International Exhibition.—A great International Exposition of Industries and Fine Arts, authorized by the Federal Government of Mexico, by decree dated January 9, 1895, will be inaugurated in the City of Mexico on April 2, 1896, and will remain open for a period of at least six months. This will be Mexico's first exposition. All who are interested in the exhibition may address A. K. Coney, Consul-General of Mexico, 604 Clay Street, San Francisco, Cal.

The Executive Committee of the Cotton States and International Exposition has ordered an annex of 35,000 sq. ft. to the Transportation Building, in order to accommodate the exhibits of locomotives and trains.

The Transportation Department promises to be one of the best features of the exhibit. Mr. Wickes, Vice-President and General Manager of the Pullman Palace Car Company, visited Atlanta last week, and perfected details for the exhibit of that Company, which will consist of the finest train of cars ever built. Several of the great railroads will have similar exhibits, and the Richmond Locomotive Works will have a fine display prepared especially for the occasion.

The Brooklyn City Railroad Company's southern station is so situated that it is necessary to carry the fuel from the wharf to the boilers, a distance of nearly 1,000 ft. This is accomplished by a very complete and economical system of transportation, by means of which the coal is taken out of the vessel and delivered to the boilers at a cost of 3 cents per ton. The machinery was designed by the C. W. Hunt Company, of 45 Broadway, New York City, and supplies the coal to a 12,000-H.P. boiler plant.

The Page Woven-wire Fence Company are seeking new fields for the introduction of their wares. In a recent letter they announce that their salesman, Mr. E. G. Fisher, sailed on the steamer *New York* on June 12, in order to represent the company at the International Railway Congress at London. Their success with the first-class roads in this country has induced them to undertake this little missionary work abroad; possibly the recent sale of 10 miles for a Government railroad in South Africa may also have had its influence. At any rate Mr. Fisher has gone abroad, and the company are bespeaking the good offices of the press of the country that are interested in the development of our foreign trade, because they feel a little shaky on the self-adjusting qualities of Mr. Fisher's French and German, and are quite sure that he will sag terribly when he attempts to speak Russian.

The Latrobe Steel Works have recently had considerable experience in forging and rolling soft steel flanges for joining sections of pipe for conveying steam, gas, water, or other liquids under high pressures. They have made these flanges of all sizes, from 6 in. up to 7 ft. in diameter. Their cross-section has usually been an ordinary angle, but they are prepared to figure on any shape. These flanges are not steel castings, but are weldless rings, forged and rolled from solid steel ingots, soft enough to readily admit of caulking at the joints. They are also free from the objections usually made to steel castings, as they are necessarily sound, solid, and without such defects as blow-holes. Their substitution for cast iron not only insures perfect safety with a material reduction in weight, but steam lines fitted with steel flanges are free from the vexation of leaky joints resulting from the unequal expansion of cast and wrought iron. They furnish large quantities of these articles for use in power houses, and in connection with marine engines, or wherever steam at high pressure is used, and have also furnished large numbers, principally of the larger diameters, for use on lines conveying water or other liquids under high pressures.

Feeding Water-tube Boilers.—The *Times* says: "In order to render the feeding of the water-tube boilers of the gunboat *Speedy* more regular than heretofore, they have just been fitted by her builders, Messrs. J. T. Thorneycroft, of Chiswick, with an automatic feeding-gear similar to that which has been found to work so well on the torpedo-boat destroyers *Daring* and *Decoy*. To keep the water level at a constant height a float controlling the feed is fitted in the upper vessel of each boiler, but the feed-gear is entirely within the boiler and operates directly on a valve fitted upon the internal feed-pipe, and as none of its moving parts have to pass through stuffing-boxes in the outer shell of the steam chamber its delicacy is not affected by the friction and consequent tightness of packing incident to the use of such boxes. Although this gear is self-contained within the steam chamber of the boiler, means are provided for adjusting it from the outside. The *Speedy* has been last fitted with the new gear, and it is reported by her engineer to have worked well."

All About Block Signals.—"Block Signals on the New York Central," the latest addition to, and No. 17 of the popular "Four-Track Series" of "America's Greatest Railroad," is from the press of the American Bank-Note Company; contains 64 pages, narrow octavo, beautifully printed on coated paper and illustrated with graphic pictures of signal apparatus and its application to the traffic of a great railroad. The text is from the pen of a celebrated English expert on block signals, and the subject is treated in a way that cannot fail to interest the average traveller, as well as the technical engineer. It is believed that this, the latest of railway safety devices, has never before been so thoroughly and comprehensively described and illustrated as in this book.

A copy will be mailed to any address, free, postpaid, on receipt of three 2-cent stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

In the Adirondack Mountains.—Persons contemplating a visit to the Adirondack Mountains should by all means possess themselves of a copy of the delightful little book, just issued by the New York Central, bearing the above title. It will not take long to read, for it contains only 64 pages, but every page bristles with information of just the practical kind one wants at such a time. You can take this book and in half an hour secure a good general idea of the Adirondack region—its grand divisions, characteristics of each, the location of the principal resorts and how to reach them.

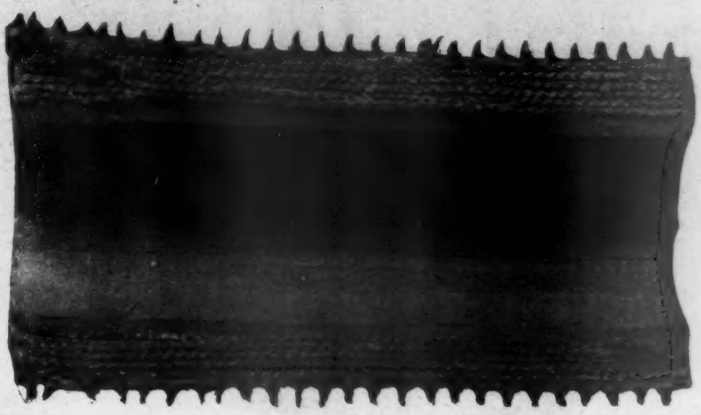
Not the least valuable feature is a fine new relief map, printed in four colors, showing the correct location of all the principal mountains, lakes and streams; also all stage lines, wagon

C. H. DALE, Pres. C. C. MILLER, Treas. BROWN CALDWELL, Sec.

PEERLESS RUBBER MANUFACTURING CO.,

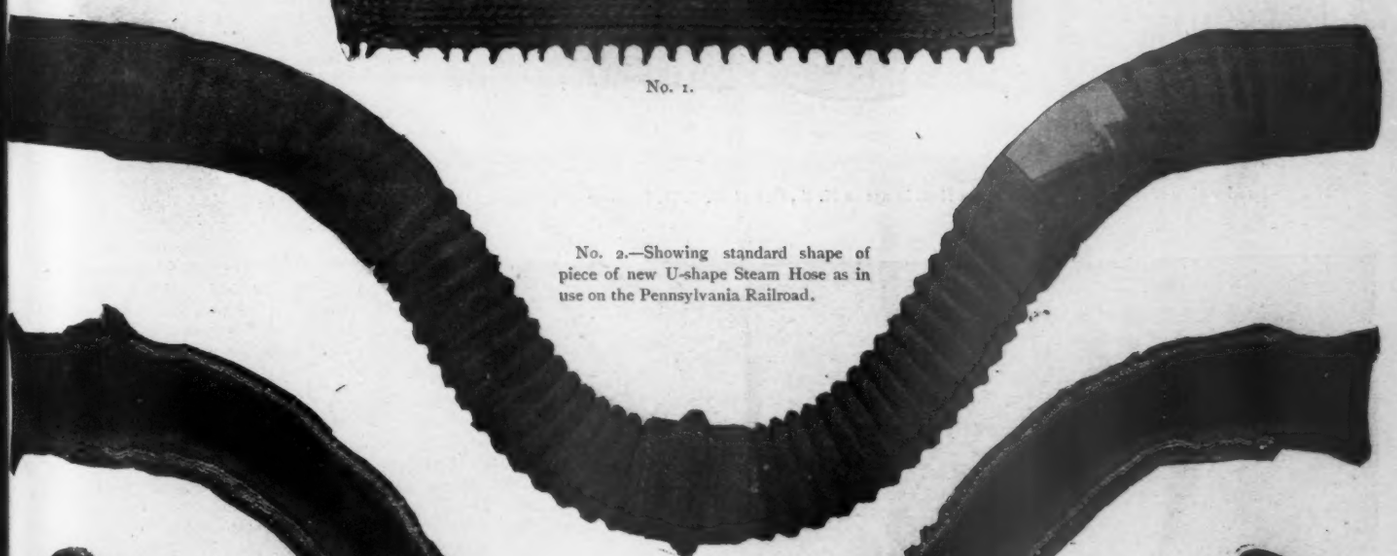
16 Warren Street, New York.

Part I.—
STEAM HOSE.



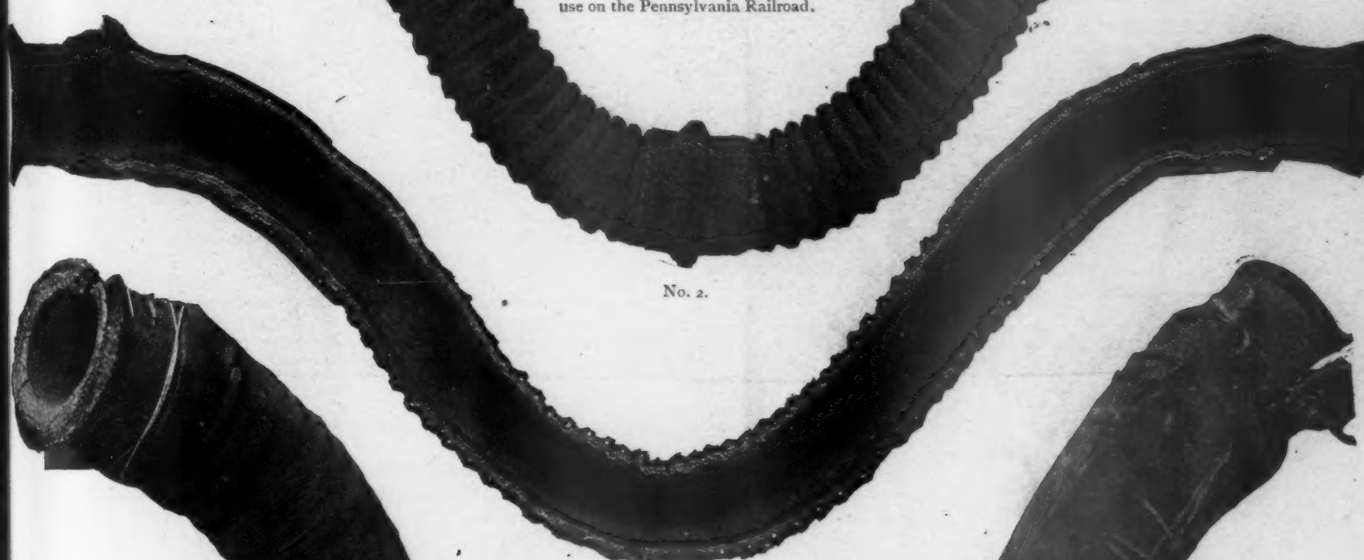
No. 1.—Interior view of Peerless Steam Hose used in electric light plants. In use for 6 months blowing off steam from 120 to 160 lbs.

No. 1.

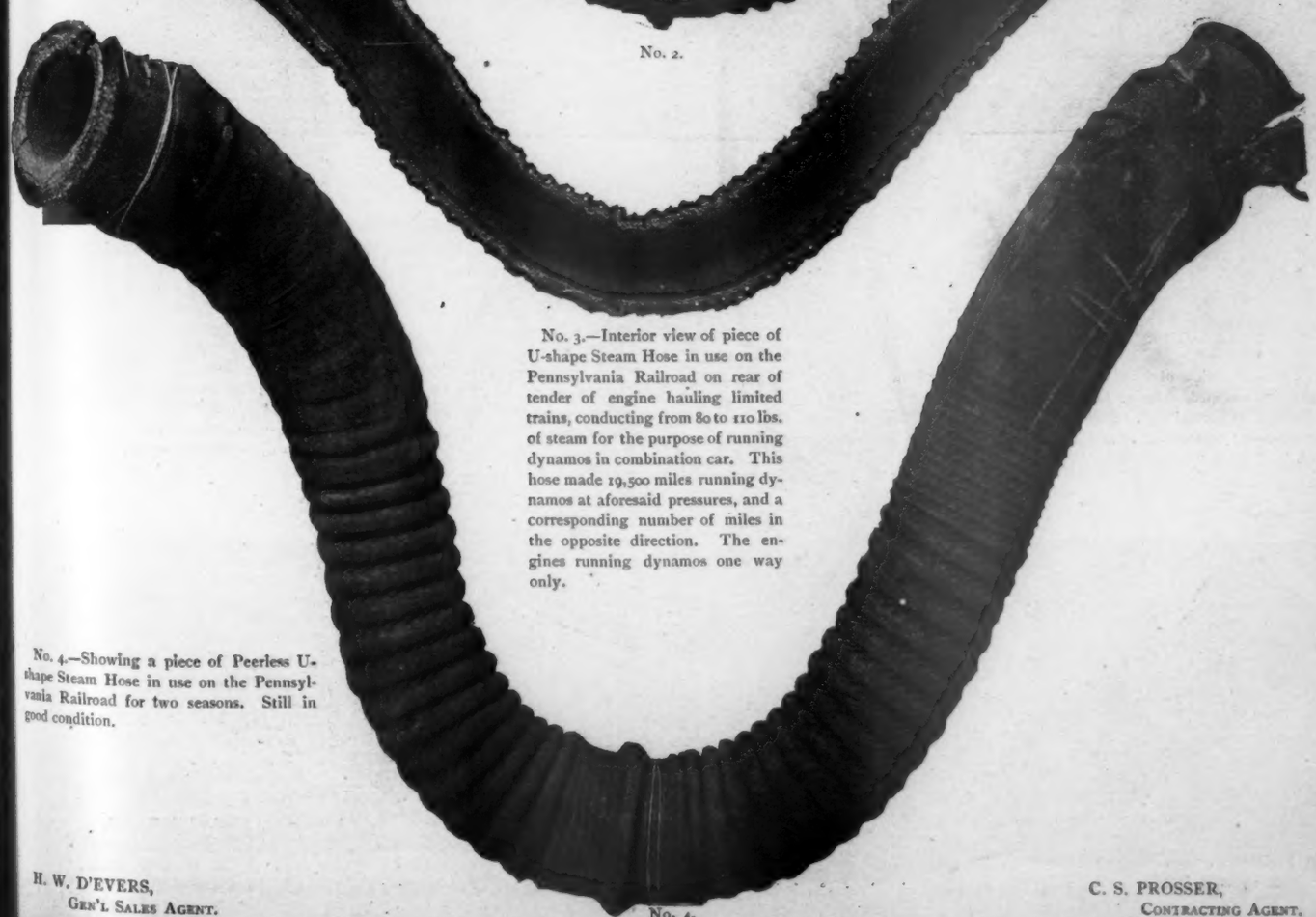


No. 2.—Showing standard shape of piece of new U-shape Steam Hose as in use on the Pennsylvania Railroad.

No. 2.



No. 3.—Interior view of piece of U-shape Steam Hose in use on the Pennsylvania Railroad on rear of tender of engine hauling limited trains, conducting from 80 to 110 lbs. of steam for the purpose of running dynamos in combination car. This hose made 19,500 miles running dynamos at aforesaid pressures, and a corresponding number of miles in the opposite direction. The engines running dynamos one way only.



No. 4.—Showing a piece of Peerless U-shape Steam Hose in use on the Pennsylvania Railroad for two seasons. Still in good condition.

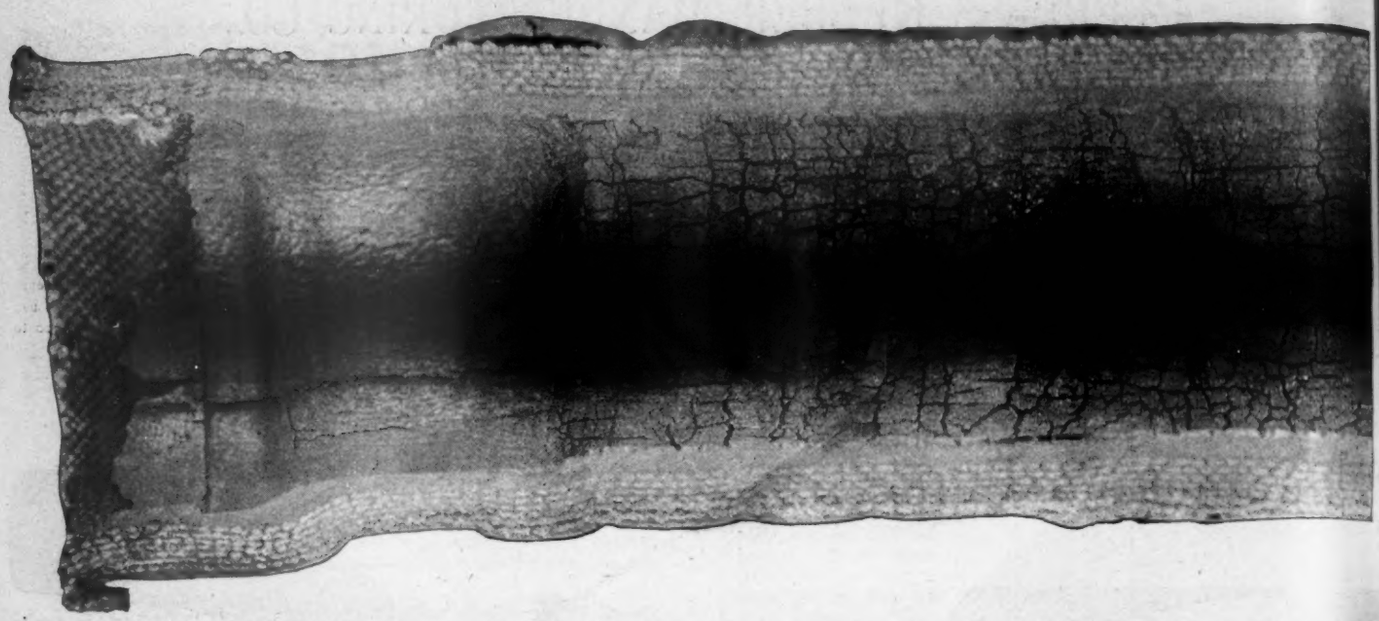
No. 4.

H. W. D'EVERS,
Gen'l Sales Agent.

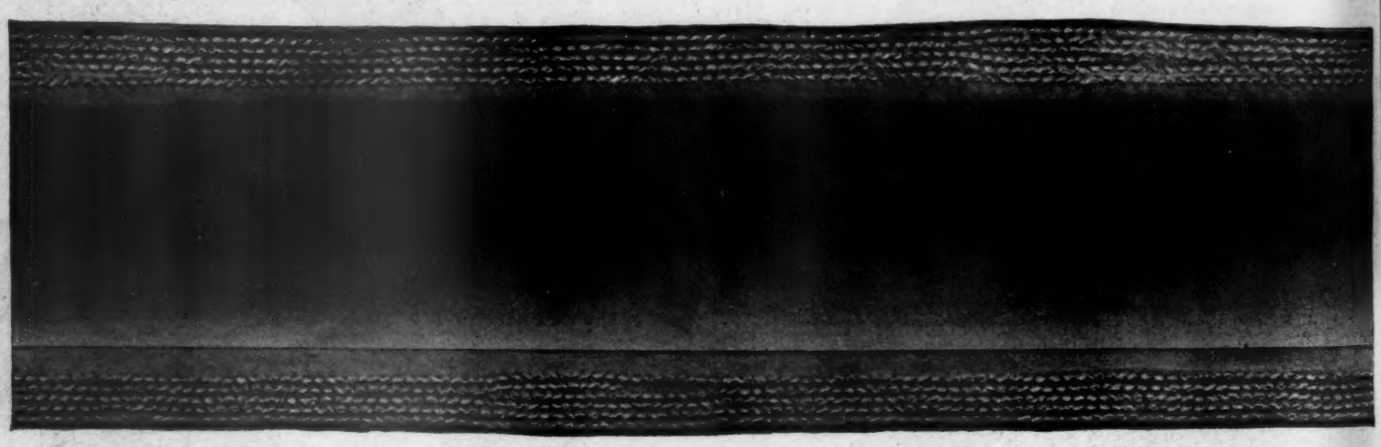
C. S. PROSSER,
Contracting Agent.

C. H. DALE,
PRESIDENT.

PEERLESS RUBBER MANUFACTURING CO.,



No. 5.—Interior view of section of Peerless Steam Hose in use on N. Y., O. and W. R. R. for three seasons, carrying from 35 to 60 lbs. steam. Still in fairly good condition.



No. 6.—Interior view of new Peerless Steam Hose, before use.

No. 10.—End view of hose made by competing company, wire wrapped, showing inside diameter decreased to one-half its normal size. Cause: cheap material, and wire wrapping contracting it and not allowing it to expand.

No. 10.

No. 8.—Exterior view of wire wrapped hose made by a competing company. Was on rear of tender of engine. Shows the hose badly burned and burst. Principal cause wire wrapping and cheap material.

No. 8.

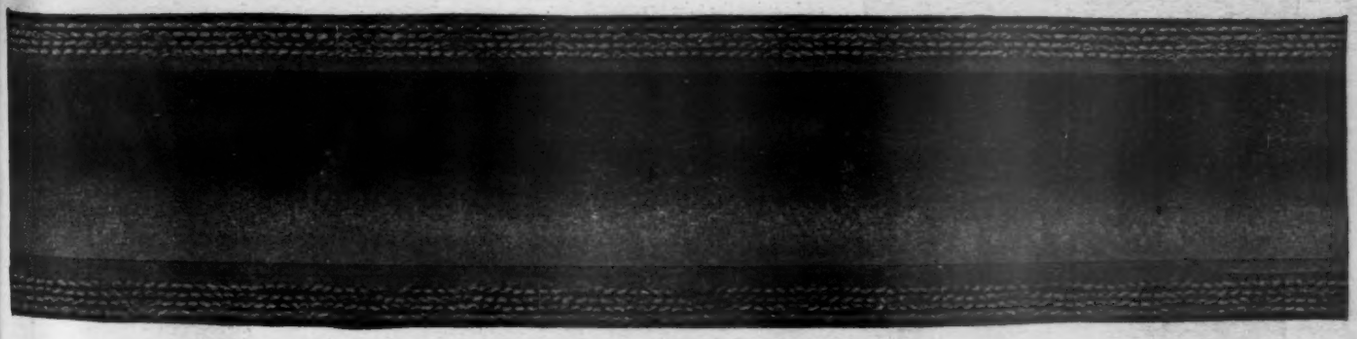
C. S. PROSSER,
CONTRACTING AGENT.

C. C. MILLER,
TREASURER.
H. W. D'EVERS,
GEN'L SALES AGENT.

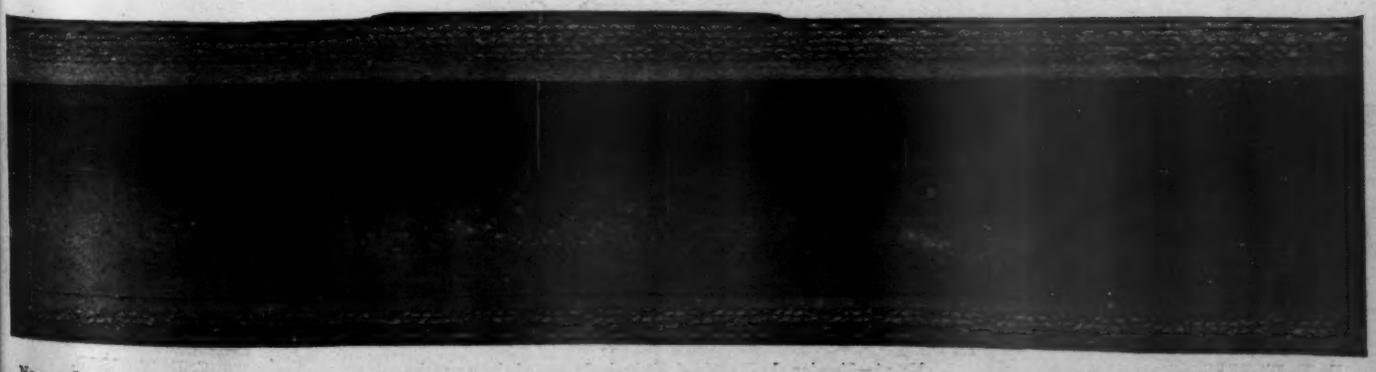
No. 9.—Interior view of competitor's hose as shown in No. 8, showing disintegration caused by the use of cheap material and wire wrapping. Hose in use only part of season.

Part II.—AIR BRAKE HOSE.

No. 11—Exterior view of new Peerless Air Brake Hose, 1¼" diameter, showing Peerless Label.



No. 12.—Interior view of one-half section of new Peerless Air Brake Hose.

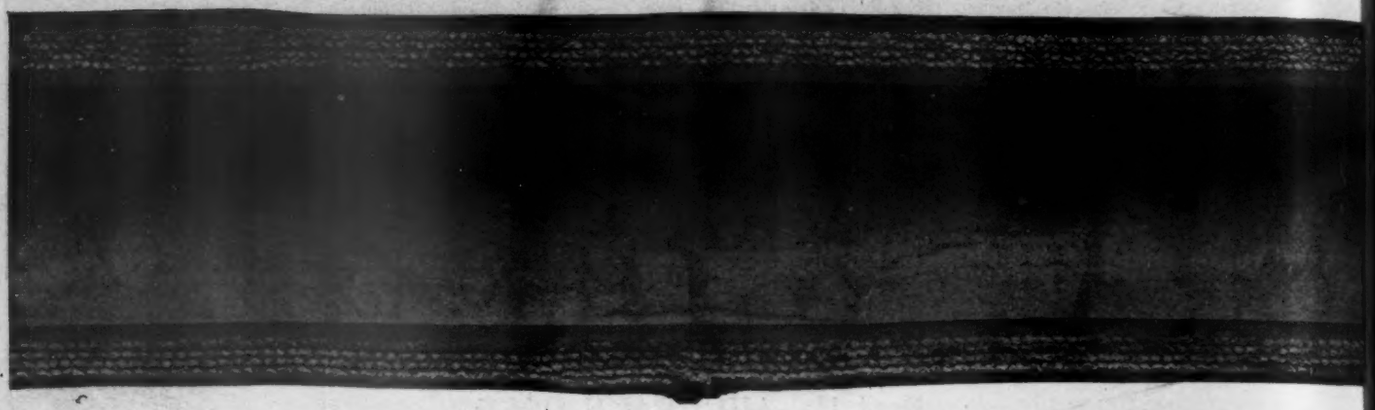


No. 13.—Interior view one-half section Peerless Air Brake Hose, in service on N. Y., O. & W. R. R. for over three years. This hose is guaranteed in passenger service for three years.

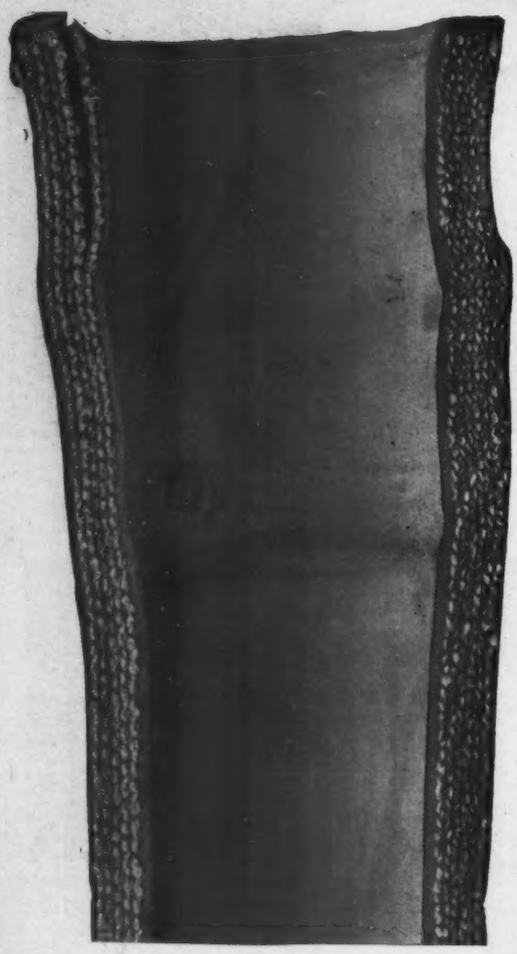
C. H. DALE, Pres. C. C. MILLER, Treas. BROWN CALDWELL, Sec.

PEERLESS RUBBER MANUFACTURING CO.,

16 Warren Street, New York.



No. 14.—Interior view of a 1¼" Air Brake Hose, in service for two years and eight months on freight equipment.



No. 15*a*.

No. 15*a* and 15*b*.—Interior view of piece of Air Brake Hose, showing injurious effects of burrs on the shank of the nipples, penetrating and cutting the tube or rubber lining.

No. 15*b*.

No. 16.—Showing cheap grade of Air Brake Hose made by competitor, where it burst at the end of the shank of the coupling.

H. W. D'EVERS, Gen'l Sales Agent.

C. D. PROSSER, Contracting Agent.

roads and carries, and on the back a complete list of hotels, cottages and camps—location, dates of opening and closing, rates, etc.

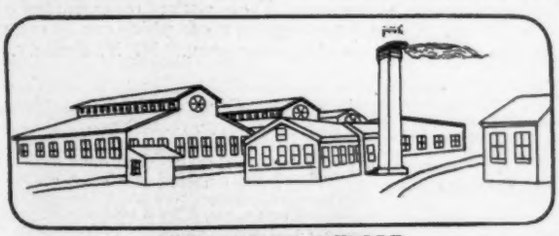
There is, probably, no other book published on the Adirondacks containing in such compact and readable shape so much useful information.

A copy will be sent free, postpaid, to any address in the world, on receipt of two 2-cent stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

The Standard Coupler Company, having a year and a half ago purchased all the patents, property, etc., of the Standard Car Coupling Company, and assumed the contracts of the same, the latter Company was during the past week granted an order in the New York Supreme Court winding up its affairs. To avoid any misapprehension in the matter, the court in its order says: "This order does not relate to and shall in no way effect the Standard Coupler Company, organized and doing business under that name in the city of New York and elsewhere, which corporation is entirely independent of and distinct from the corporation herein sought to be dissolved."

The Link Belt Machinery Company, Chicago, has just completed for the C. C. Washburn Flouring Mill Company, Minneapolis, Minn., the machinery for a 1,200 H.P. rope transmission. The motive power is a large triple-expansion engine made in Germany and exhibited at the World's Fair. To this is coupled a steel shaft 31 ft. long in two pieces, 11¼ in. in diameter, swelled to 15 in. to receive the fly-wheel, which is 14 ft. in diameter, with 20 grooves for 2-in. rope, and weighs 38,000 lbs. This shaft is supported in pillow blocks on heavy cast-iron sole plates set on stone foundations. From the fly-wheel power is transmitted to a sheave 10 ft. 8 in. in diameter, having 20 grooves for 2-in. rope and weighing 21,500 lbs. There is a single idler of the same diameter running loose on each side of it, leading to the rope off the tension carriages. This driven sheave is put on a cast-steel quill 15 in. in diameter, weighing 4,000 lbs., which runs on its own bearings. The mill shaft passes through this quill, and receives power from it by means of a pair of flanged faced couplings. The bearings for the quill are set on cast-iron pedestals 5 ft. high. Each pedestal and pillow block weighs 7,700 lbs. Two tension carriages with 7-ft. sheaves and 3,600 ft. of 2-in. special red thread manilla transmission rope complete the drive.

The McShane Company, of Baltimore, Md., are putting in a new plant for their iron foundry at Dundalk, on Colgate's Creek, and expect to have it in full operation by August 1. The foundry proper is already completed inside and out, and all that remains to be done is the placing in position of the machinery, melting pots, etc. The building is frame, and is 300 ft. long × 260 ft. wide. Large sliding window frames extend around the entire building. The lifts, derricks, transfer cranes, etc., for the inside will be of the most improved



THE DUNDALK FOUNDRY.

pattern. Dundalk, which has an area of 20 acres, is situated on Colgate's Creek, about 8 miles from Baltimore, and within a short distance of Sparrow's Point, where the Pennsylvania Steel Company has its mammoth plant. The Sparrow's Point Branch of the Pennsylvania Railroad runs right in front of the new foundry. The name of the place, Dundalk, is the name of the native town of the McShane family.

Compressed Air as a Motive Power.—A test of compressed air as a motive power for rapid-transit cars will shortly be made in Baltimore, for the purpose of demonstrating the efficiency and comparative cost of this means of propulsion. For this purpose two cars are being built at the shops of Ryan & McDonald, at Curtis Bay, Baltimore, and it is expected that they will be completed and ready for their trial trip in two or three weeks. Air compressors for the purpose of charging the cars are being constructed by the Rand Drill Company, of New York, and will be ready in about the same time.

The new cars will make their first trips on the Baltimore, Catonsville & Ellicott City Railway, negotiations to this effect having been completed by Mr. John B. McDonald, President of the American Compressed-Air Motor Company, and Mr. Bernard N. Baker, President of that railway. Mr. McDonald says the experiment may also be made on the Traction Company's power-houses without trouble. If the cars are run on the tracks of the Baltimore, Catonsville & Ellicott City Railway, it will be necessary to obtain a boiler and engine to compress the air, as that Company has no power-house of its own.

The new cars will be of the ordinary size and dimensions, with the same seating capacity as those now used. The controlling device for the motorman is simple and positive in effect, occupying no more platform space than the ordinary brake-handle. All the other mechanism is under the car floor.

In process of operation the air is compressed to from 1,000 to 2,000 lbs. per square inch, and stored in the station tank. With sufficient storage capacity in the station, the time occupied in charging the car, either automatically or by hand device, need not take more than half a minute. The storage capacity of the seamless steel flasks or containers in the car is sufficient to operate the car from 12 to 15 miles or more, according to the pressure.

After passing through a reducing valve and being lowered to whatever is desired as a working pressure, the air is circulated through hot water, and the mixture of heated air and vaporized water passes to the motors, working expansively. The mechanical features of the motors are substantially identical with those of a steam locomotive.

It is said that the manipulation of the car is simplicity itself, that it is noiseless, and operates without jars or jerks, and is under perfect control at all times. As great a rate of speed as desired may be attained, and, besides, compressed air as a motive power is said to stand at the head of the list as far as economy is concerned.

A PLEASANT OUTING

can be had by trip over the picturesque LEHIGH VALLEY RAILROAD to the MOUNTAINS OF PENNSYLVANIA, the LAKE REGION OF NEW YORK STATE, or NIAGARA FALLS.

Send four cents in stamps for printed matter descriptive of the line to CHARLES S. LEE, General Passenger Agent, Philadelphia, Pa.

MAP OF THE UNITED STATES.

A LARGE, handsome map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of 15 cents in postage by P. S. Eustis, General Passenger Agent, Chicago, Burlington & Quincy Railroad, Chicago, Ill.

THE PENNSYLVANIA RAILROAD

is favored with the patronage of the best class of travelers.

Why?

Because, with complete protection by the block-signal, automatic and interlocking switches, and an unsurpassed roadbed, it is the safest.

Because, with a superb service of perfectly appointed trains, it is the most comfortable.

Because, with wise management and unlimited facilities, it is the promptest.

These reasons are heavy, and they tip the balance on the side of the "standard railway of America."

"BODY RESTED, MIND AT EASE."

That is what it is when travelling on the fast trains of the Chicago, Milwaukee & St. Paul Railway; besides there is no chance to "kick," for the accommodations are up to date, the trains keep moving right along and get there on time. These lines thoroughly cover the territory between Chicago, La Crosse, St. Paul, Minneapolis, Aberdeen, Mitchell, Sioux Falls, Sioux City, Yankton, Council Bluffs, Omaha and Northern Michigan. All the principal cities and towns in that territory are reached by the "St. Paul" lines, connecting at St. Paul, Council Bluffs and Omaha with all lines for points in the far west. Write to Geo. H. Heafford, General Passenger and Ticket Agent, Chicago, Ill., for one of their new map time tables and a brochure giving a description of the Compartment Sleeping Cars. Tickets furnished by any coupon ticket agent in the United States and Canada. The finest dining cars in the world are run on the solid vestibuled, electric-lighted and steam-heated trains of the Chicago, Milwaukee & St. Paul Railway.

Bucyrus Dredges.—The Bucyrus Steam Shovel & Dredge Company have sent some interesting illustrations and descriptions of dredges and steam shovels recently manufactured by them. One of these, called "The Ram," was designed for special work in the lower Mississippi, and especially at the mouth of the Red River, where at low water it has been impossible to maintain a navigable channel. The dredging machine is attached to what appears like an ordinary western steamboat, which is fitted with a stern wheel and engines of the usual Mississippi pattern, and it is said will make a speed of 10 miles per hour. Its capacity, according to the contract requirements, was 300 cub. yds. of solid material per hour, to be delivered at a distance of not less than 300 ft. and at an elevation of 10 ft. It was also provided that the dredge should be capable of working in stiff clay and sand, and should be able to cut its own flotation through a solid bank. In a test made some time ago it more than exceeded the guaranteed capacity. Another dredge illustrated was built for the harbor commissioners of Montreal, where it had to handle shale, hard pan and boulders. An interesting illustration shows a boulder or mass of rock about twice the capacity of the "dipper," but of elongated form, so that one end of it could enter, and which was taken up by this machine. Steam shovels of various types are also a specialty of this company. Some excellent reports of the performance of these machines accompany the circulars.

Substitute for Red Lead.—The traditional substance which has been used in machine shops and elsewhere from the time "when the memory of man runneth not to the contrary," for making steam-tight joints has been red lead. The Dixon Crucible Company have for 12 or 15 years been making a compound composed largely of plumbago, first known by the inelegant term "smear grease." Later this name was changed to "pipe-joint grease." As this company say, it really is not a grease, and as the name has caused some misunderstanding, its name has again been changed to "Dixon's Graphite Pipe-joint Compound," which we suggest is too long, although it does not affect the merits of the material. It is not only useful for *tight* joints in all steam, gas and water piping, but is equally useful for smearing gaskets and flange joints of metres, traps, and for bolts, screws, etc. We suggest as a substitute for the above cumbrous name, "Gra. Dix.," which would have a sort of scientific aspect, or it might be called "Tightum," because it makes tight joints—see! It is said to be excellent stuff, however, no matter by what name it is known.

Electric Light Plant of the Steamer "Bay State."—The Belknap Motor Company, of Portland, Me., have recently installed on the new steamer *Bay State*, of the Boston & Portland Line, an electric light plant which has some points of interest.

The dynamos are multipolar slow-speed machines of 400 lights capacity each, but either machine will carry the entire load amounting to 540 lights. It has become a general practice to use duplicate plants for marine work, so in case an accident should happen to either engine or dynamo the duplicate machine can do the work. The dynamos were designed by Mr. W. H. Chapman, electrician for the company, and their successful working has secured further orders for the installation of two direct coupled machines for the steamer *Portland* of the same line, also for the steamship *St. Croix*, of the International Steamship Company, which is practically under the same board of management. In the system of wiring there are eight main circuits controlled at the switchboard in the dynamo-room which lead to 16 different distributing boxes containing switches located in different parts of the boat, each switch controlling six lights, turning them on or off as may be desired. These distributing boxes have glass fronts secured with lock and key and are under the control of the steward of the boat. There are pilot lights on the main and fore rigging and at the bows of the boat.

The fixtures are of the latest design with opalescent globes and shades. The dining saloon is fitted with ground-glass globes, which gives this part of the boat a very cheery and pleasing effect. The freight deck lights are protected with guarded fixtures.

The boat at night presents a brilliant spectacle, surpassing in all its appointments anything that can be found in eastern waters, the Sound lines alone excepted. The addition of this new boat has been the means of popularizing this line with the best class of the travelling public.

BOOKS FOR ENGINEERS AND MECHANICS.

The number of books, pamphlets and periodicals on engineering and mechanical subjects in existence, and which is published annually, is no so large that no engineer, mechanic or railroad employee can hope to read more than a very small fraction of them, and it is of the utmost importanc that such persons should read only the best. Besides the really valuable books which are written by competent persons, who are experts in the subject about which they have written, there is every year a large number of poor ones published which are written by more or less conceited or stupid incompe tents, or by those whose only motive in writing is to make their names known, and such books it is, to a great extent, a waste of time to read and waste of money to buy. This, as some one has written, "makes it extremely difficult for engineers, mechanics and railroad employees, anxious t keep themselves informed about their business, to know what it is really worth their while to read. They cannot read all that appears, for lack o time, and much of it is not worth reading; yet in the absence of capable criticisms of such works, they cannot easily learn what is really good."

These considerations, and the letters which an editor constantly receives enquiring about books and asking for information about them, ha led me to conclude that it might be beneficial to many persons, especially to mechanics and others, whose information concerning the literatu relating to their occupations is somewhat limited, and that it would be perfectly proper to recommend certain books which deserve recommendatio and give some information about their value and character. With this in view, the following notices of books have been prepared, and their value an character have been as well indicated as has been possible in such brief descriptions as are here given. These notices represent my own estima of the character and value of the books to which they refer, and none will be noticed in this list, excepting those which can be recommended t readers, although it may be with some qualifications, as it is seldom that either books or people are altogether good. M. N. FORNEY.

The Steam Engine.

By GEORGE C. V. HOLMES. 5×7 in. 528 pp. Price, $2.00.

Is a more complete treatise on the steam engine than Ripper's book, and is also of recent date, and well up to modern practice. It is perhaps the best book on the general subject of the steam engine that a student, mechanic or young engineer can read. It is not very elaborately illustrated, but has 212 excellent wood cuts. It contains no mathematics more difficult than algebra, and not much of that. The science of heat and steam is treated in the earlier chapters, the theory of the steam engine follows. These are succeeded by descriptions of the mechanism of engines and boilers, and the concluding chapters are on compound engines. It does not relate especially to stationary, locomotive or marine engines, but the principles and construction of all these are discussed.

A Hand-Book of the Steam Engine.

By HERMAN HAEDER, C. E. 440 pp. 4¾×7 in. Price, $3.00.

The title page of this book—which is translated from the German—says that it has especial reference to small and medium-sized engines for the use of engine makers, mechanical draughtsmen, engineering students, and users of steam power. It is illustrated by over a thousand engravings showing the construction of stationary engines and their details. The general plan of the book is to show the construction of the engines and their parts by engravings and brief descriptions. Its defect is that the descriptions are often not full enough, and do not make the subject to which they relate entirely clear. The engines illustrated are chiefly of German construction, and for that reason, will have very great interest to American mechanics. The book contains little about the theory of the steam engine, and the only mathematics in it, are constructional calculations, and some algebra, but the latter is of a very simple kind, and there is not much of that. In studying the details of construction of small steam engines, this book will be an excellent aid, notwithstanding the defect referred to.

The Catechism of the Locomotive.

By M. N. FORNEY. Second Edition. 709 pages 6×8 in., and six folded plates. Price, $3.50.

As its name implies, this book is written in the form of questions and answers, and as one of its reviewers said "is written on a low plane;" that is, the subjects to which it relates are explained in the simplest and clearest language that the author could command. As stated in the preface, his object in writing the book "was to furnish a clear and easily understood description of the principles, construction, and operation of the locomotive engine of the present day." There are but two mathematical elucidations in it, and they are in foot notes. It contains nearly 500 engravings which illustrate very fully, different classes of American locomotives and the construction of their parts. The principles and practice involved in these and in the operation of the whole machines are very fully explained, the aim being to make it "plain to plain people." At the same time, the subject was brought fully up to the practice which prevailed when this edition was first brought out, which was in 1889. The book is suited for engineers, mechanics, firemen, students, and, in short, any one who wants information about the principles and constructiou of the locomotive of the present day.

Compound Locomotives.

By PROF. ARTHUR TANNATT WOODS. Second edition revise and enlarged by David Leonard Barnes. 330 pp. 5¾×8¾ in. 166 engravings. Price, $3.00.

The purpose of this book is to give a description of t theory and construction of the Compound Locomotive in most recent forms. This is admirably done and in a form clear that it can be readily understood by any one at acquainted with the subject of locomotive engineering. is not an elementary book on the locomotive, but an expl nation of compound locomotives for those who are acquainte with the principles and details of simple engines.

The Construction of the Modern Locomotive

By GEORGE HUGHES. 261 pp. 5½×8¾ in. 309 Fi 3 folded plates. Price, $3.50.

As its title indicates, and as the author says, "design not touched upon" in what he has written. "Each section he says, "describes, step by step, more minutely, and such drawings and illustrations as have not appeared befo in one volume, the actual progress of the work done that station." The author is an Englishman and describ how an English locomotive is built, or how the work done in the boiler-shop, iron and brass foundries, the for and "smithy," coppersmith's work, machine and erecti shops. The methods of doing work is illustrated by e gravings from original drawings. American readers w be interested in some of the methods in use in British shop which differ somewhat from American practice. The boo is a good one, but considering what an excellent subject t author had, what he has written and published ought have been better than it is.

Any of the above books will be sent, prepaid, on receipt of the price, or information will be given, on application, with reference to the character an value of other books on mechanical engineering. Address, M. N. FORNEY, 47 Cedar Street, New York

F. W. DEVOE & CO., (ESTABLISHED 1852.)

Fulton Street, Cor. William, New York.

FURNISHERS OF

Paints, Coach Colors, Fine Varnishes.

According to Specifications, to

Pennsylvania Railroad Company,
New York Central & Hudson River R.R.,
New York, Lake Erie & Western Ry.,
Del., Lack. & Western Ry.,
and others.

Steam Heating from the Locomotive:
Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,199. **SEWALL COUPLERS** sold 55,617; the standard in U. S. and Canada.

Electric Heaters for Street Cars:
1,103 Car Equipments sold from Aug. 1 to Dec. 1. West End Boston, People's Traction Philadelphia, Nassau Ry. Brooklyn, Union Ry. Providence and Buffalo Railway have recently ordered over 700 Car Equipments.

CONSOLIDATED ALBANY CAR-HEATING CO.

Pope Light Compressed Oil Gas:
Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

Albany, N. Y., 413-423 North Pearl Street:
CHICAGO, 200 WESTERN UNION B'LD'G; Canada, Coaticook, P. Q.—London—Moscow. Specially tested fittings and car lighting repair parts at reasonable prices. Electric Heaters for offices.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.

ESTABLISHED 1824. A SCHOOL OF ENGINEERING. SEND FOR A CATALOGUE.

TRADE VALENTINES MARK.

VALENTINE & COMPANY,

MANUFACTURERS OF HIGH GRADE

Coach and Railway Varnishes and Colors,

57 BROADWAY, NEW YORK.

Wabash Ave., CHICAGO. *164 Purchase St., BOSTON.* *21 Rue de Lappe, PARIS.*

Non-Corrosive Priming and Finishing Paint
For Engines, Machinery, etc.
This paint being entirely free from acid, will not corrode or rust the iron.

Patent Iron Filler
For Tools, Machinery, Engines, Locomotives, Tenders, Iron Ships, and all Iron Work for Buildings, inside or out.

Pure Oxide Paints
For Bridges and General Construct'on Work.
Send for sample cards and prices.

FELTON, SIBLEY & CO.,
Philadelphia, Pa.

PRESSES, DIES, AND OTHER
SHEET-METAL TOOLS
FERRACUTE MACHINE CO
BRIDGETON N. JERSEY U.S.A.

Facts Worth-Knowing

ABOUT **Pressure Regulators**
(Reducing Valves)
For Railroad, Steamship, and other Service.

44-page Hand-Book mailed free.

FOSTER ENGINEERING CO.,
NEWARK, N. J.

RUE "1889" INJECTOR

"LITTLE GIANT"
Mfg. Co., PHILA., PA.

THE AMERICAN BALL PULVERIZER.

SPECIALTIES:

Am. Crusher and Am. Ball Pulverizer.

The Simplest, Cheapest and Best Machines in the Market. Pulverize wet or dry to any degree of fineness. Makes little or no slimes in wet nor dust in dry work. Four sizes, capacity from 2 to 60 tons per day.

SEND FOR CATALOGUE.
Cable Address, American.

First Prize and Gold Medal Awarded by World's Fair, 1893.

THE American Mining & Milling Machinery Co.

29 Euclid Ave., CLEVELAND, O. 280 Caxton Block, CHICAGO, ILL.

Office of THE CLEVELAND IRON ORE PAINT CO. and THE GARRY IRON ROOFING CO.,
CLEVELAND, O., Jan. 25, 1894.

The American Mining and Milling Machinery Co., Cleveland, O.:

GENTLEMEN: We purchased a No. 2 American Rock Breaker and a No. 2 American Ball Pulverizer from your company about one year ago. The latter part of April, 1893, we started up for regular work, since which time we have run both of said machines to the full extent of our demands and to our entire satisfaction. The first 700 tons of hard iron ore that we pulverized for paint purposes was ground without taking the Pulverizer apart, and without expending one dollar for repairs for either of these machines. Of the 700 tons spoken of, about 200 tons was Lake Superior Specular Iron Ore, containing some 70 per cent. iron; a very difficult ore to pulverize. The remainder was a red fossiliferous iron ore, carrying quite a per cent. of silex, which cuts out buhr stones rapidly. We find that the steel balls, which were when new 5 in. in diameter, now caliper 4⅞ in., and are perfectly round and smooth. The grinding track shows very little wear, and the driving track shows less; in fact the wear is almost imperceptible. These two machines crush and pulverize more than one ton per hour with less than 12 H.P. We do not know of any Crusher or Pulverizer that can compare with the output of these two machines in quantity, quality, small amount of wear and tear, and like power. In our opinion you cannot recommend them too highly.

Very truly yours, CLEVELAND IRON ORE PAINT CO.

AMERICAN ENGINEER AND RAILROAD JOURNAL.
(Formerly the RAILROAD AND ENGINEERING JOURNAL.)

PUBLISHERS' DEPARTMENT.

General Notes.

Car-wheel Tires to be Made in Chicago.—It is reported that the Chicago Tire & Spring Company's plant at Melrose, near Chicago, will pass into the hands of the Latrobe Steel Tire & Iron Company, who will establish the manufacture of steel tires at that point.

Recovering Soiled Cotton Waste.—Some of the European railway companies have introduced the practice of recovering their soiled cotton waste by the use of sodium silicate, being able in that way to renew the value of the same a dozen times instead of two or three, as in the usual employment of caustic soda. Silicate soda is also a good agent in the bleaching of jute or hemp waste.

The Abendroth & Root Manufacturing Company has of late filled a number of notable orders for their improved Root water-tube boiler, principally in New York City and vicinity. It may be mentioned in this connection that Arthur Loretz, Jr., formerly New York manager for the National Water-tube Boiler Company, is now representing the Root boiler at 28 Cliff Street, New York City.

British Engineers and Spanish Steamers.—"By an order of the Spanish Government just issued," says the Liverpool *Journal of Commerce*, "all steamers sailing under the Spanish flag or subsidized by the Spanish Government will, in future, carry none but Spanish engineers. The prevailing practice at present is to carry at least two British engineers on each Spanish steamer, and formerly all the engineers were British."

The De Laval Impulse Engine is making way in France During 12 months past the French company have built 39 plants for electrical work fitted with the turbines, some of them being of 300 H.P. From a private letter we learn that a good many of the flexible spindles on which the wheels are mounted, break, and this is not to be wondered at. This is a fad, we may call it, of the inventor, and we think of no importance whatever, because other more durable mechanical expedients will answer the same purpose. It is nearly impossible to perfectly balance a body to run at a rate of 10,000 to 15,000 revolutions per minute; and the doctor mounts his wheels on slim shafts that will bend, and thus permit the wheel, like a spinning top, to assume a theoretical centre of gyration. Any kind of yielding support will do this. An engine or wheel made here by Mr. W. A. Doble was fixed on an overhanging shaft, which is in effect the same thing, but the true way seems to be in providing a movable bearing, as in the case of centrifugal extractors.—*Industry*.

Boston Belting Company.—This Company has secured the services of Mr. Thomas R. Freeman to represent it among the railroad trade of the country. He was formerly connected with the Hale & Kilburn Manufacturing Company, of Philadelphia, and is widely known among railroad men. He will probably make his headquarters in Chicago, but will be more or less ubiquitious in behalf of the Company which he will represent.

The Eastman Kodak Company is installing in its works at Rochester, N. Y., a system of narrow-gauge cars and tracks by which cars loaded with glass may be transferred from one track to any number of tracks parallel to it. To accomplish this they are to use a transfer car with rails on top which runs on an auxiliary track perpendicular to the others. This system of cars and track is the design of the C. W. Hunt Company, of New York.

A Steamer Running on Rails is a curious sight to be seen near Copenhagen. Two lakes are separated by a narrow strip of land, on which rails are laid running into the water on either side. The steamer, which is 44 ft. long and carries 70 passengers, is guided to the rails by piles like a ferry slip; it has wheels on either side which fit the rails, and is driven full speed up one side of the incline and down the other into the water on the other side.

Effect of Quick-firing Guns on Torpedo-boats.—The British War Office authorities have decided to carry out a series of experiments at Shoeburyness to test the effect of the firing of quick-firing guns on torpedo-boats. A section of a torpedo-boat, fitted with an engine and boiler, and stored with coal in her bunkers, has been specially constructed, and is being placed in position at Shoeburyness. The section is to be embedded in sand to the water-line, and will offer a target of about 50 ft. in length.

Morris Machine Works.—The Company which is the successor of Heald, Sisco & Co. and Heald & Morris, of Baldwinsville, N. Y., and whose specialty is the manufacture of centrifugal pumping machinery, has established a New York office at 39 and 41 Cortlandt Street. It will be under the management of Messrs. Hungerford Bros. & Co., who will always be on hand to serve the public and the Company which they are fully authorized to represent.

The Westinghouse Machine Company's steam-engines find a market in the remotest corners of the earth. A 150-H.P. compound of the latest type was recently shipped to Alaska. The trade of this Company in foreign parts holds up well, orders having just been completed for three 150-H.P. compounds to Mexico; 200-H.P. compound to Spain; 300-H.P. compound to France; 150-H P. compound to Buenos Ayres; 800-H.P. compound to Havana, Cuba, besides a number of smaller engines to Russia and elsewhere.

Fast Time to the Pacific Coast.—The Southern Pacific Railway will begin on October 1 to run a semi-weekly "Sunset Limited" train between New Orleans and San Francisco. Only one such train a week is now being run, but it is believed that travel, especially during the Atlanta Exposition, will be largely increased. Under the new arrangement passengers leaving New York on Tuesday and Saturday evenings of each week will make a close connection at New Orleans on Thursday and Monday mornings for San Francisco. Under the present schedule the travel between New York and Los Angeles over the Southern Pacific and by the "Sunset Limited" is 17 hours shorter than by the northerly routes. When the additional "limited" is established the time will be shortened three hours.

The Trial of the "St. Louis."—The American Line's new steamer *St. Louis* had an official trial in the English Channel on August 20, and maintained a speed of 23.3 knots an hour for over four hours. The course was from Portland Bill to Start Point, a distance of 52 nautical miles. The *St. Louis* made a flying start due west with the tide. The time consumed was two hours, 12 minutes and five seconds, showing a speed of 23.6 knots. The return trip was made in two hours, 28 minutes, 37 seconds, at a speed of 21 knots. The sea was smooth. There was on board 450 tons of ordinary coal of the same quality that is used on regular voyages. Her draft was 23 ft. forward and 24 ft. aft. The quantity of coal usually carried on her voyages is 2,500 tons, and the draft of the vessel is then a foot deeper than it was on this trial. When the range was passed the screws were making 95 revolutions per minute and the vessel was remarkably steady.

A Powerful Sea-going Dredging Steamer.—One of the largest hydraulic dredging steamers that has been built in this country is now approaching completion at the yards of Hugh Ramsay, Perth Amboy, N. J., for the United States Government. This vessel is being built by the Bucyrus Steam Shovel & Dredge Company, of South Milwaukee, Wis., for the harbor works at Galveston, Tex., Major A. M. Miller, engineer in charge, and is constructed throughout from the designs of Mr. A. W. Robinson, Chief Engineer of the Company. It is equipped with two centrifugal pumps, each having a capacity of 300 cub. yds. of sand per hour, or 600 yds. for both. These deliver the sand into the internal hoppers of the vessel, which have a capacity of 600 cub. yds. The vessel is a complete ocean-going steamship in every particular, being equipped with compound propelling engines of 500 H.P., which enable her to steam at a speed of 10 knots, and her equipment includes two powerful electric searchlights, as well as all modern appliances which go to make up a first-class vessel. The vessel has been named the *General C. B. Comstock*, and is expected to be ready for service this summer, and her performance will be watched with great interest.

Bethlehem Iron Company.—Fisher & Porter, 1025 Monadnock Block, Western Agents for the Bethlehem Iron Company, report that the business outlook in their line is very encouraging. They say that they have done more business in the past two months than during the preceding first five months of the year. Showing the diversity of uses for which their

No Air Valves or Pumps,
No Leaking or Freezing,
No Pipes, Rusted Chain or Cranks,

Operated from Grade or Tower House,
Guaranteed Absolutely for a Period of Years,
A Practical Summer and Winter Gate.

THE DAYTON RAILWAY CROSSING GATE.

ERECTED ON TRIAL, SUBJECT TO ACCEPTANCE AND APPROVAL.

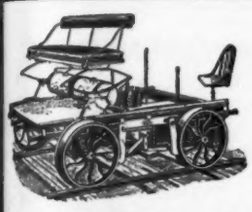
ESTIMATES FURNISHED.

THE CRAIG-REYNOLDS FOUNDRY CO.,

DAYTON, OHIO.

EASTERN AGENT,
ERNEST S. CRONISE, Room 33, 37 Broad St., New York.

WESTERN AGENT,
JOHN McKINNON, 374 The Rookery Bldg., Chicago, Ill.



Kalamazoo R. R. Velocipede Car Co.,

KALAMAZOO, MICH., U. S. A.

Gasoline Motor Inspection Car.

It has no fire exposed.
It is free from any possibility of explosion.
It is ready to start at a moment's notice.

PERFECTLY RELIABLE.

MANUFACTURERS OF

WHEEL HAND CARS, STEEL VELOCIPEDE CARS, STEEL SURFACE CATTLE GUARDS, and a New RAILWAY TRICYCLE, constructed with ball bearings and throughout similar to a road bicycle.

Send for Catalogue and mention this Journal.

NEW YORK CENTRAL & HUDSON RIVER R. R.

The Great Four-Track Trunk Line of America.

Wagner Palace Sleeping and Drawing-Room Cars on all Through Trains.

All through trains arrive at and depart from Grand Central Station, Fourth Ave. and 42d Street, New York, the very centre of the city.

John M. Toucey, Gen'l Manager.
Geo. H. Daniels, Gen'l Passenger Agent.

The Direct Line between New York AND Niagara Falls.

MACHINERY CUTS A SPECIALTY.
JAMES S. CONANT & CO.
3 Franklin St., BOSTON.
Engravers on Wood

PENNSYLVANIA RAILROAD.

The Standard Railroad of America.

The Only Four-track Line Leading Out of New York City.

Connecting all the principal cities on the Atlantic Coast with those in the Mississippi Valley and on the Great Lakes. Through trains with Pullman Vestibule, Buffet, Sleeping and Dining Cars attached, between New York, Philadelphia, Washington and Baltimore and Chicago, St. Louis, Cincinnati and Louisville.

S. M. PREVOST, General Manager. J. R. WOOD, General Passenger Agent.

"LET KNOWLEDGE GROW FROM MORE TO MORE"

KNOWLEDGE

AN ILLUSTRATED MAGAZINE OF SCIENCE

SIMPLY WORDED—EXACTLY DESCRIBED

Contains articles on the following subjects written by the ablest authorities.

Astronomy, Entomology, Mineralogy,
Natural History, Paleontology, Hygiene,
Botany, Geography, Electricity,
Geology, Chemistry, Etc., Etc., Etc.

In fact all matters interesting to readers having a taste for Science.
Each number beautifully illustrated with FULL PAGE PHOTOGRAPHIC REPRODUCTIONS AND OTHER ILLUSTRATIONS.

Monthly, Sixpence. Annual Subscription, Post Free, 8s.
OR TWO DOLLARS

WITHERBY & CO., 326, High Holborn, LONDON, W. C.

"THE GRAPHIC OF THE SCIENTIFIC WORLD"

JOHN A. WILSON, *Civil Engineer.* JOSEPH M. WILSON, *Civil Engineer and Architect.* HENRY W. WILSON, *Civil Engineer.*

WILSON BROTHERS & CO.,

Civil Engineers, Architects and Consulting Engineers.

CHAS. G. DARRACH, *Civil & Hydraulic Eng'r.* | DREXEL BUILDING: Cor. Chestnut and Fifth Streets, | HENRY A. MACOMB, *Architect.*

PHILADELPHIA, PA.

SOOYSMITH & CO.,

Incorporated,

CONTRACTING ENGINEERS,

MILLS BUILDING, 15 BROAD ST., NEW YORK.

PASCHKE, VAN HORNE & KELLEY,

CIVIL ENGINEERS

Rooms 716, 717 & 718 Havemeyer Building, New York City.
Cable Address: "Paskel." A. B. C. or Anglo-American Code.

All kinds of Surveys carefully made. Plans and Specifications for Railroads, Water Works, Water Power, Sewerage, and their superintendence Topographical Relief Models made. Examinations and Reports upon all Public Enterprises and Properties in Spanish-American Countries.

Correspondence in English, Spanish, German and French.

LOUIS P. EVANS,

Engineer and Contractor,

Designs furnished if required. Railroad Bridges and Trestle Work. Mill and Factory Buildings, etc.

S. E. Corner 4th and Walnut Sts., Philadelphia, Pa.

GOOD PATENTS

PROCURED IN ALL COUNTRIES.
GRANT INSURED.
30 YEARS' PRACTICE.

Reliable, prompt service. Fair charges. Advice as to patentability. Pamphlet and References *free*. Write to

CHAS. J. GOOCH, Patent Attorney, WASHINGTON, D. C.

GEO. L. FOWLER,

Consulting Mechanical Engineer,

53 BROADWAY, NEW YORK.

ALFRED A. HUNTING,

Consulting and Mechanical Engineer,

Plans of Steam Plants for Mills and Street Railways a Specialty.

618 John Hancock Building, Boston, Mass.

WM. A. ROSENBAUM,

ELECTRICAL EXPERT AND SOLICITOR OF PATENTS,

Formerly Manager of, now successor to, the Patent Business heretofore conducted by "The Electrical World."

Times Building, New York.

forgings have been required, they mention the following: Hollow plungers for hydraulic elevators; hollow quills for malt-house and grain elevators; hollow forged cylinders and shafts for ore separators; hollow piston-rods of nickel steel for rock drills and channelling machines; sockets for drills for coal-mining machines; hollow forged shafts for electric railway engines, West Chicago Street Railroad; hollow piston-rods for blooming engines for Ohio Steel Company, Youngstown, O., and Apollo Steel Company, Vandergrift, Pa.; hollow shafting for rotary gas-engines; hollow spindles for lathes; hollow forged nickel steel piston-rods for drop hammers; cross-heads and pins, cranks and pins, connecting-rods, piston rods, rocker-arms, cam shafts, main shafts, etc., for stationary engines and pumps of all sizes, also for ice machines and air compressors; shafts for blowing engines for Carnegie Steel Company, Pittsburg; shafts for rolling-mill engines for Illinois Steel Company, Chicago; shafts for electric generators and motors; piston-rods and shafts for lake steamers; single, double, and quadruple throw solid forged crank-shafts for gas-engines; shafts and roller shells for ore crushers; stems and rollers for stamp mills; suction and delivery valves for pumping engines; spindles for turret lathes; rail-posts for railroad crossings; piston-heads and rams for steam hammers; piston-rods for drop hammers; axles for gun carriages for United States Government; polar and declination axes for Yerkes telescope and other smaller telescopes.

A PLEASANT OUTING

can be had by trip over the picturesque LEHIGH VALLEY RAILROAD to the MOUNTAINS OF PENNSYLVANIA, the LAKE REGION OF NEW YORK STATE, or NIAGARA FALLS.

Send four cents in stamps for printed matter descriptive of the line to CHARLES S. LEE, General Passenger Agent, Philadelphia, Pa.

THE PENNSYLVANIA RAILROAD

is favored with the patronage of the best class of travelers.

Why?

Because, with complete protection by the block-signal, automatic and interlocking switches, and an unsurpassed road-bed, it is the safest.

Because, with a superb service of perfectly appointed trains, it is the most comfortable.

Because, with wise management and unlimited facilities, it is the promptest.

These reasons are heavy, and they tip the balance on the side of the "standard railway of America."

MAP OF THE UNITED STATES.

A LARGE, handsome map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of 15 cents in postage by P. S. Eustis, General Passenger Agent, Chicago, Burlington & Quincy Railroad, Chicago, Ill.

WANTED.

CHIEF ENGINEER for a large steam plant in New Jersey; triple-expansion, Corliss and other engines. Salary, $2,500 per year to A1 man. Address, with copies of references, "Mentone," office AMERICAN ENGINEER, 47 Cedar Street.

TO MANUFACTURERS OF RAILWAY SUPPLIES.

POSITION WANTED as Traveling or Local Agent by a gentleman who has long acted in former capacity for large corporations, and who has a wide acquaintance among railway officials. References unexceptionable. Salary moderate.

Address R, Office AMERICAN ENGINEER AND RAILROAD JOURNAL, 47 Cedar Street, New York.

"BODY RESTED, MIND AT EASE."

That is what it is when travelling on the fast trains of the Chicago, Milwaukee & St. Paul Railway; besides there is no chance to "kick," for the accommodations are up to date, the trains keep moving right along and get there on time. These lines thoroughly cover the territory between Chicago, La Crosse, St. Paul, Minneapolis, Aberdeen, Mitchell, Sioux Falls, Sioux City, Yankton, Council Bluffs, Omaha and Northern Michigan. All the principal cities and towns in that territory are reached by the "St. Paul" lines, connecting at St. Paul, Council Bluffs and Omaha with all lines for points in the far west. Write to Geo. H. Heafford, General Passenger and Ticket Agent, Chicago, Ill., for one of their new map time tables and a brochure giving a description of the Compartment Sleeping Cars. Tickets furnished by any coupon ticket agent in the United States and Canada. The finest dining cars in the world are run on the solid vestibuled, electric-lighted and steam-heated trains of the Chicago, Milwaukee & St. Paul Railway.

Proceedings of the Conference
—ON—
AËRIAL NAVIGATION,
HELD IN
CHICAGO, AUGUST 1, 2, 3 AND 4, 1893.

429 pages, 5¾ x 9 in.

Sent by mail on receipt of price, which is $2.50.

An International Conference on Aërial Navigation formed one of the series of "Congresses" which were held in Chicago during the summer of 1893, when the Columbian International Exhibition was opened. The meetings of this Conference proved to be successful and interesting beyond expectation. The efforts of the committee in charge of them to secure the co-operation of scientific men and capable engineers, and reports of experimental investigations, facts and positive knowledge rather than speculations or descriptions of projects was abundantly rewarded. Some thirty-five papers were contributed, covering many of the problems of Aëronautics and Aviation, and presenting the observations and results of experiments of experts who are eminent as scientific men or experienced engineers, or both. The subject was taken out of the hands of "cranks," and was discussed by those who, by reason of their knowledge and training, were competent to do so. These papers and the discussions thereon, all of which are of very great interest to those who have any concern in the fascinating subject of Aërostation, have been published in a volume of over 400 pages.

PROGRESS IN FLYING MACHINES.

BY O. CHANUTE, C. E.

308 pages, 5¾ x 8½ in.

Sent by mail on receipt of price, which is $2.50.

This book gives an historical review of the efforts and experiments of inventors to accomplish flight with apparatus, which by reason of its rapid movement will be supported by the air as birds are. The author has gathered all the records of such experiments which were accessible, and has endeavored to show the reasons for their failure and to explain the principles which govern flight, and to satisfy himself and his readers, whether we may reasonably hope eventually to fly through the air. His conclusion is that this question may now be answered in the affirmative. A full account is given of the recent experiments of scientists like Maxim, Lilienthal, Hargraves and Langley. The book contains over 300 pagillustes and is rated by nearly 100 engravings.

Mr Chanute has brought together in this volume about all that is worth saying on the subject of aerostation. He sketches the intelligent attempts that have been made, gives their records, theory of work and probable causes of failure. He shows what the scientfic principles of flight are, and after discussing the difficulties which surround the subject, the progress which has been made and the difficulties which remain unsolved, he adheres to his conviction that real progress has been made, and that the problem will ultimately be solved. —*Independent.*

AMERICAN ENGINEER'S REFERENCE CARDS.

Some months ago the first of a series of **Reference Cards** was issued by the AMERICAN ENGINEER AND RAILROAD JOURNAL. These contain data to which engineers, mechanics, draftsmen and others have frequent occasion to refer. They are printed on strong manilla cards (5 x 7 in.) which will bear much handling. Thus far six of these cards have been published, as follows:

No. 1. *Proportions for Sellers' U. S. or Franklin Institute Screw Threads, Nuts and Bolt Heads.*
No. 2. *Symbolical Shading and Colors for Drawings of Cross-sections of Different Materials.*
No. 3. *Standard Dimensions, Heating-Surface, etc., of Lap Welded Iron Boiler Tubes.*
No. 4. *Weights, Evaporative Powers per Weight and Bulk, etc., of Coals.*
No. 5. *Standard Form and Proportions for the Treads and Flanges of Car Wheels, the Gauge of Wheels, Frogs, etc.*

The last card which has been published is No. 6, which contains Instructions to Boiler Attendants, as Issued by the Manchester Steam Users' Association. (Double No.).

It is thought that all persons, firms or companies using boilers, and who must of necessity incur the responsibility which such use implies, should place a copy of these rules in the hands of the person or persons who have the care of their boilers. Engineers and firemen who to a very great extent are responsible for the safety and economical management of boilers will find no better guide in the performance of their duties, than is embodied in these rules which have been prepared by the above Association. They should be placed in every boiler room.

Copies of any of the above cards may be obtained by sending a two cent postage stamp for each one to the publisher of the **American Engineer and Railroad Journal.**

They are issued for the convenience of those who frequently have occasion to make use of the data they contain. The collateral purpose which the cards are intended to serve—that of making the **American Engineer and Railroad Journal** and its contents known to a class of persons for whom it is intended—will not, it is thought, lessen the usefulness or convenience of the tables in the form in which they are printed.

Orders should be sent to **M. N. FORNEY**, Editor and Proprietor of the American Engineer and Railroad Journal, 47 Cedar Street, New York.

F. W. DEVOE & CO., (ESTABLISHED 1852.)

Fulton Street, Cor. William, New York.

FURNISHERS OF

Paints, Coach Colors, Fine Varnishes.

According to Specifications, to

Pennsylvania Railroad Company,
New York Central & Hudson River R.R.,
New York, Lake Erie & Western Ry.,
Del., Lack. & Western Ry.,
and others.

Steam Heating from the Locomotive:
Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,199. **SEWALL COUPLERS** sold 55,617; the standard in U. S. and Canada.

Electric Heaters for Street Cars:
1,103 Car Equipments sold from Aug. 1 to Dec. 1. West End Boston, People's Traction Philadelphia, Nassau Ry. Brooklyn, Union Ry. Providence and Buffalo Railway have recently ordered over 700 Car Equipments.

CONSOLIDATED CAR-HEATING CO.

ALBANY

Pope Light Compressed Oil Gas:
Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

Albany, N. Y., 413-423 North Pearl Street:
CHICAGO, 200 WESTERN UNION B'LD'G; Canada, Coaticook, P. Q.—London—Moscow. Specially tested fittings and car lighting repair parts at reasonable prices. Electric Heaters for offices.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.

ESTABLISHED 1824. A SCHOOL OF ENGINEERING. SEND FOR A CATALOGUE.

TRADE VALENTINES MARK.

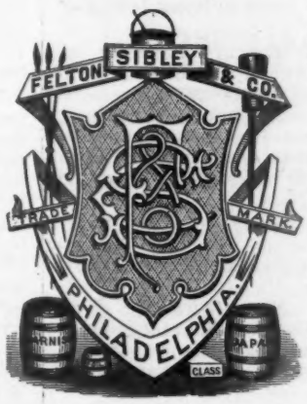
VALENTINE & COMPANY,

MANUFACTURERS OF HIGH GRADE

Coach and Railway Varnishes and Colors,

57 BROADWAY, NEW YORK.

390 Wabash Ave., CHICAGO. *164 Purchase St., BOSTON.* *21 Rue de Lappe, PARIS.*



Non-Corrosive Priming and Finishing Paint

For Engines, Machinery, etc.

This paint being entirely free from acid, will not corrode or rust the iron.

Patent Iron Filler

For Tools, Machinery, Engines, Locomotives, Tenders, Iron Ships, and all Iron Work for Buildings, inside or out.

Pure Oxide Paints

For Bridges and General Construction Work.

Send for sample cards and prices.

FELTON, SIBLEY & CO.,
Philadelphia, Pa.

PRESSES, DIES, AND OTHER
SHEET METAL TOOLS
FERRACUTE MACHINE CO.
BRIDGETON N.J. U.S.A.

"1889" "LITTLE GIANT"
RUE INJECTOR
Mfg. Co., PHILA., PA.

Facts Worth-Knowing ABOUT Pressure Regulators (Reducing Valves)

For Railroad, Steamship, and other Service.

44-page Hand-Book mailed free.

FOSTER ENGINEERING CO.,
NEWARK, N. J.

---

800 IN USE
For Naval and Marine Purposes

The ROBERTS SAFETY WATER TUBE BOILER

SEND FOR HANDSOME ILLUSTRATED CATALOGUE 39 CORTLANDT STREET, N. Y.

Political Reform

BY THE

Representation of Minorities.

By M. N. FORNEY.

The Book is published by the author, and will be sent by mail on receipt of the price, which is $1.50.

47 CEDAR ST., N. Y.

The aim of this book is, first, to describe briefly the evils growing out of the present system of electing by a majority of the votes cast in each district, single members to represent the people in it, in national, State, and municipal legislative assemblies; second, to show how some of these evils would be remedied by giving minorities as well as majorities representation in our legislative bodies; third, to describe how this is done in Illinois by the system of cumulative voting, which was adopted in that State more than twenty years ago for the election of members of its House of Representatives; fourth, to describe the results and workings of that system, and show its advantages and disadvantages; fifth, to indicate how the latter may be obviated; sixth, to describe a method of election which, it is thought, would overcome the difficulties inherent in cumulative voting; seventh, to show how the proposed method of election would lessen many of the political evils from which we are now suffering, and to indicate the reforms which would result therefrom; eighth, to compare some of the different systems which have been proposed for securing minority representation and show their merits and defects; and ninth, to give a bibliography of minority or proportional representation for those who are disposed to give the subject more extended study.

AMERICAN ENGINEER AND RAILROAD JOURNAL.
(Formerly the RAILROAD AND ENGINEERING JOURNAL.)

PUBLISHERS' DEPARTMENT.

General Notes.

The Foster Engineering Company, of Newark, N. J., recently equipped 15 locomotives of the Lehigh Valley Railroad with their inside safety boiler checks, and have just received an additional order from the same road for 30 more of the checks.

The Taylor Iron & Steel Company, High Bridge, N. J., have recently installed the C. W. Hunt Company system of cars and track for handling their material, also the Otis Company, of Ware, Mass., have again added to their already very complete system of Hunt industrial railways.

Henry L. Leach announces that during the month of August he shipped 101 sets of his pneumatic track-sanding apparatus, the last set being numbered 2,168. Of these 30 sets were for the Lake Shore & Michigan Southern and 10 for the Burlington, Cedar Rapids & Northern; 13 went on the Southern Railway, and the rest were scattered over the country on roads ranging from the Banger & Aroostook and the Houston & Texas Central.

The Firm of Fisher & Porter was dissolved by mutual consent on September 30. Mr. Albert Fisher will retain their present office, Room 1025, Monadnock Block, and will represent William Todd & Co., of Youngstown, O., on their high grade and heavy duty engines, rolling mill and blast furnace machinery. Mr. H. F. J. Porter will retain the agency of the Bethlehem Iron Company, and will move to Room 1433 Marquette Building.

Aluminum Bronze.—The Waldo Foundry Company, of Bridgeport, Conn., have issued a circular in which they announce their preparedness to furnish aluminum bronze castings, sheets and wire, phosphor bronze, aluminum in castings, sheets, wire, and seamless tubing, anti-friction metals of several grades, special alloys which can be tested in their chemical and mechanical laboratory, which is equipped with all the needed appliances for making such tests.

The Tabor Manufacturing Company, of New York, builders of automatic foundry moulding machines, has recently been reorganized with the following officers: Harris Tabor, President; Angus Sinclair, Vice-President; E. H. Mumford, Secretary and Treasurer. New life has been given to the introduction of power moulding machines for foundry work, in which foundrymen are showing great interest, and the Company feels sure of greater success for itself and for its machine than ever before."

The Knowles Steam Pump Works announce that, referring "to the recent fire in our works in Warren, Mass., we have noticed in a number of the papers exaggerated reports of the occurrence. We take this means of informing our friends and patrons that the fire was confined to the iron foundry and to one of the pattern houses, and that the total loss will not exceed $140,000, fully covered by insurance. Our facilities are such that very little, if any, interruption will be caused to our business by the above-named fire."

Exhaustion of Naval Engineers.—The daily papers report the prostration, it is alleged from overwork, of Chief Engineer Kirby of the United States battleship *Texas*, and it is said he is the fifth engineer to give way this year under the terrible physical and mental strain to which the engineer officers are subjected. The size, power, complexity, and power of resistance of our ships have been enormously increased, but there has been no corresponding addition made to the power of resistance of the engineers. Will only some great disaster bring about a reform in the engine-room?

The Peerless Rubber Company have received from Mr. Henry J. Reynolds, the chief engineer of the steamer *Northland*, of the Northern Steamship Company, the following letter in regard to the packing made by the Peerless Company: "I have used Rainbow packing for steam and hot-water pressures of 266 lbs. and 500 to 600 lbs. respectively, and find it superior to all others. Before using Rainbow packing I tried various other packings, including corrugated copper, and found that they would not hold. I therefore tried Rainbow packing, and can cheerfully recommend it as being the only packing for all high pressures in the market to-day."

Test of Holtzer Projectiles.—A test of Holtzer armor-piercing projectiles, manufactured by the Midval Steel Company, was made at Sandy Hook on September 19. Four of the projectiles were fired at an 11¼ in. nickel steel armor plate, and in each case the projectile passed cleanly through the plate, then through 3 ft. of oak backing, and penetrated for a considerable distance into the sand butt. The projectiles were then dug out and found to be in perfect condition. Each shell weighed 57 lbs., and was fired so that it struck the plate at a velocity of 1,620 ft. per second.

High Speed of the Electric Locomotive in Baltimore.—The *Baltimore Sun* is authority for the statement that the electric locomotive in the Baltimore & Ohio tunnel recently ran at the rate of 61 miles per hour. At this speed what is called the "flexible trolley" mechanism worked satisfactorily, although some difficulty was at first encountered owing to the heating of the trolley shoe. This was attributed to an accumulation of scale in the electric conduit during the period of construction. This has been removed, and no further trouble is anticipated.

United States Gunboats, Nos. 7, 8, and 9, under construction at Newport News, will be equipped throughout with the Foster pressure regulators and reducing-valves, the Foster Engineering Company, of Newark, N. J., having just entered an order for a large number of valves for that purpose.

The Lidgerwood Manufacturing Company are giving publicity to an interesting fact to contractors, as revealed by the use of the various systems of handling rock on the Chicago Main Drainage Canal. A day's work for a man in filling limestone into shallow skips, as used on the Lidgerwood Cableway, averages between 16 and 17 cub. yds. of rock in place for each 10 hours' work, while the work of filling the cars, which are about 3 ft. high, averages only about 9 cub. yds. per man. This is a remarkable saving, and alone would justify the use of the cableway in hundreds of localities. It may be mentioned in this connection that there are now 20 Lidgerwood cableways, which are manufactured solely by the Lidgerwood Manufacturing Company, New York, in use in the construction of the Chicago Main Drainage Canal.

The Phosphor-Bronze Smelting Company announce that they have purchased the processes and the exclusive right for the manufacture of Delta metal in the United States, and are now prepared to furnish the same in castings, stampings, forgings, bolts, etc., of equal quality to those made in Europe. Delta metal has established an enviable reputation throughout England and the continent for exceptionally high properties; it possesses strength equal to mild steel, with great rigidity, toughness, and resistance to corrosion, and is especially adapted for use in propellers, blades and shafts, heavy and light gearing, drop forgings and stampings, valve-stems, screws, bolts, and nuts, and all purposes requiring exceptional strength at moderate cost. These alloys are not offered as a substitute for the well-known "Elephant Brand" phosphor-bronze, but occupy a field distinctively their own.

The Horseless Vehicle Contest.—The horseless vehicle contest that has been organized by the Chicago *Times-Herald* will take place on Saturday, November 2, and the run will be from some point in or near the city of Milwaukee to some point in or near Chicago, not farther south than the southern limit of Lincoln Park. The first prize will be $2,000 and a gold medal, and will be open to the competition of the world. The second prize will be $1,500, and will be awarded to an American machine, provided that the first prize is carried off by a foreigner. The third prize will be $1,000, and the fourth $500. It is stipulated that each vehicle must contain within itself all of the means for generating the power needed for its propulsion, and must carry at least two persons, one of whom can be the person in charge. In awarding the prizes the judges will take into consideration the general utility of the machine, its speed, cost, economy of operation, and general appearance.

Test of Armor Plate for the "Iowa."—On September 17 the final test of the armor plate for the United States battleship *Iowa* was held at Indian Head. The target was 18 ft. long, 7 ft. 6 in. high, and 6 ft. 6 in. deep. The face was a 14-in. double forged steel plate backed by 5 in. of oak, and fastened by bolts to the framing. In the previous tests two shots had been fired at this plate from the 10-in. gun and one from the 12 in. gun without injuring the framing in the least, while the plate itself more than exceeded requirements, although penetrated and slightly cracked by the shot from the larger gun. This last test was for the purpose of ascertaining

No Air Valves or Pumps,
No Leaking or Freezing,
No Pipes, Rusted Chain or Cranks,

Operated from Grade or Tower House,
Guaranteed Absolutely for a Period of Years,
A Practical Summer and Winter Gate.

THE DAYTON RAILWAY CROSSING GATE.

ERECTED ON TRIAL, SUBJECT TO ACCEPTANCE AND APPROVAL.

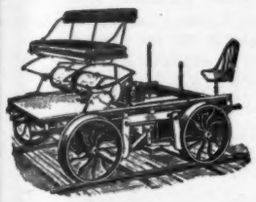
ESTIMATES FURNISHED.

THE CRAIG-REYNOLDS FOUNDRY CO.,

DAYTON, OHIO.

EASTERN AGENT,
ERNEST S. CRONISE, Room 33, 37 Broad St., New York.

WESTERN AGENT,
JOHN McKINNON, 374 The Rookery Bldg., Chicago, Ill.



Kalamazoo R. R. Velocipede and Car Co.,

KALAMAZOO, MICH., U. S. A.

Gasoline Motor Inspection Car.

It has no fire exposed.
It is free from any possibility of explosion.
It is ready to start at a moment's notice.

PERFECTLY RELIABLE.

MANUFACTURERS OF

STEEL WHEEL HAND CARS, STEEL VELOCIPEDE CARS, STEEL SURFACE CATTLE GUARDS, and a New RAILWAY TRICYCLE, constructed with ball bearings and throughout similar to a road bicycle.

Send for Catalogue and mention this Journal.

NEW YORK CENTRAL & HUDSON RIVER R. R.

The Great Four-Track Trunk Line of America.

Wagner Palace Sleeping and Drawing-Room Cars on all Through Trains.

All through trains arrive at and depart from Grand Central Station, Fourth Ave. and 42d Street, New York, the very centre of the city.

John M. Toucey, Gen'l Manager.
Geo. H. Daniels, Gen'l Passenger Agent.

The Direct Line between New York AND Niagara Falls.

MACHINERY — CUTS — A SPECIALTY.

JAMES S. CONANT & CO.

Engravers on Wood

3 Franklin St., BOSTON.

PENNSYLVANIA RAILROAD.

The Standard Railroad of America.

The Only Four-track Line Leading Out of New York City.

Connecting all the principal cities on the Atlantic Coast with those in the Mississippi Valley and on the Great Lakes. Through trains with Pullman Vestibule, Buffet, Sleeping and Dining Cars attached, between New York, Philadelphia, Washington and Baltimore and Chicago, St. Louis, Cincinnati and Louisville.

S. M. PREVOST, General Manager. J. R. WOOD, General Passenger Agent.

"LET KNOWLEDGE GROW FROM MORE TO MORE"

KNOWLEDGE

AN ILLUSTRATED MAGAZINE OF SCIENCE

SIMPLY WORDED—EXACTLY DESCRIBED

Contains articles on the following subjects written by the ablest authorities.

Astronomy, Entomology, Mineralogy,
Natural History, Paleontology, Hygiene,
Botany, Geography, Electricity,
Geology, Chemistry, Etc., Etc., Etc.

In fact all matters interesting to readers having a taste for Science.
Each number beautifully illustrated with FULL PAGE PHOTOGRAPHIC REPRODUCTIONS AND OTHER ILLUSTRATIONS.

Monthly, Sixpence. Annual Subscription, Post Free, 8s.
OR TWO DOLLARS

WITHERBY & CO., 326, High Holborn, LONDON, W. C.

"THE GRAPHIC OF THE SCIENTIFIC WORLD".

JOHN A. WILSON, *Civil Engineer.* JOSEPH M. WILSON, *Civil Engineer and Architect.* HENRY W. WILSON *Civil Engineer.*

WILSON BROTHERS & CO.,

Civil Engineers, Architects and Consulting Engineers.

CHAS. G. DARRACH, *Civil & Hydraulic Eng'r.* DREXEL BUILDING: Cor. Chestnut and Fifth Streets, HENRY A. MACOMB, *Architect.*

PHILADELPHIA, PA.

SOOYSMITH & CO.,

Incorporated,

CONTRACTING ENGINEERS,

MILLS BUILDING, 15 BROAD ST., NEW YORK.

PASCHKE, VAN HORNE & KELLEY,

CIVIL ENGINEERS

Rooms 716, 717 & 718 Havemeyer Building, New York City.
Cable Address: "Paskel." A. B. C. or Anglo-American Code.

All kinds of Surveys carefully made. Plans and Specifications for Railroads, Water Works, Water Power, Sewerage, and their superintendence Topographical Relief Models made. Examinations and Reports upon all Public Enterprises and Properties in Spanish-American Countries.

Correspondence in English, Spanish, German and French.

LOUIS P. EVANS,

Engineer and Contractor,

Designs furnished if required. Railroad Bridges and Trestle Work. Mill and Factory Buildings, etc.

S. E. Corner 4th and Walnut Sts., Philadelphia, Pa.

GOOD PATENTS

PROCURED IN ALL COUNTRIES.
GRANT INSURED.
30 YEARS' PRACTICE.

Reliable, prompt service. Fair charges. Advice as to patentability. Pamphlet and References *free*. Write to

CHAS. J. GOOCH, Patent Attorney, WASHINGTON, D. C.

GEO. L. FOWLER,

Consulting Mechanical Engineer,

53 BROADWAY, NEW YORK.

ALFRED A. HUNTING,

Consulting and Mechanical Engineer,

Plans of Steam Plants for Mills and Street Railways a Specialty.

618 John Hancock Building, Boston, Mass.

WM. A. ROSENBAUM,

ELECTRICAL EXPERT AND SOLICITOR OF PATENTS,

Formerly Manager of, now successor to, the Patent Business heretofore conducted by "The Electrical World."

Times Building, New York.

what damage would result to the framing of a ship if her armor were pierced by a projectile, and a 13-in. gun was therefore used. The shot weighed 1,000 lbs., and a velocity of 1,800 ft. per second was given by a charge of 480 lbs. of brown powder. Only one shot was fired, and that passed through the plate backing, etc., and, striking some object, was deflected and lost in the woods back of the target. The plate exceeded expectations, two cracks, in addition to the hole made by the shell, being the extent of the damage. As for the framing, the only question was whether the damage would be local, confined to that portion through which the projectile passed, or whether the entire structure would be demolished, the rivets pulled out, and the bulkheads buckled. Three divisions through which the shell tore its way were crumpled like paper, and were partly carried away with the projectile, but the remainder of the framing was unharmed and not a rivet started. This experiment is, we believe, the first that has been made with the framing of modern war vessels, and seems to have demonstrated that it is as strong as the armor, as that used was an exact duplication of the side section of the *Iowa*.

The United States Cruiser "Columbia's" Voyage Across the Atlantic.—The *Nautical Magazine* (English) in commenting upon the recent test of the *Columbia* in crossing from the Needles to Sandy Hook Lightship, a distance of 3,112 miles, in 6 days, 23 hours, 49 minutes, with a coal consumption, it is said, of only 200–230 tons per diem, says:

"The question at once arises, could any British cruiser equal this performance, and we fear that the answer would be in the negative. The *Royal Arthur*, a cruiser of equal tonnage to the *Columbia*, has recently had a 24 hours' trial in the Pacific, and attained the truly portentous speed of 16.5 knots as the average and a maximum for four hours of 18 knots. The *Blenheim* steamed 14 knots on her homeward trip from Halifax.

"Reverting to the *Columbia*, it must in fairness be stated that her trial was conducted under favorable conditions of weather, but nothing can be said to detract from its merit. She was hotly chased by the Hamburg-American liner *Augusta Victoria*, which left Southampton 100 miles behind her, but she never caught up the cruiser, although she beat her in time by 3½ hours. To do this she used forced draft. The *Paris* has done a best performance of 20.48 knots; the *Majestic*, 20.10; the *Teutonic*, 20.34; the *Normannia*, 19.08; the *New York*, 20.15; the *Campania*, 21.54; and the *Lucania*, 22.01, at a consumption of 560 tons of coal per diem. It is obvious that few of our best boats could escape from the *Columbia* under ordinary circumstances, and still less were she to employ forced draft. Her sister ship, the *Minneapolis*, has a better record on the measured mile, and would in all probability be proportionately her superior under like conditions at sea. It should be stated that some naval authorities look upon this as demonstrating the value of the triple screw. One of the chief engineers of the *Columbia*, however, holds that she would have done still better had the blades of the centre screw been removed and all the work thrown on the wing screws."

WANTED.

CHIEF ENGINEER for a large steam plant in New Jersey; triple-expansion, Corliss and other engines. Salary, $2,500 per year to A1 man. Address, with copies of references, "Mentone," office AMERICAN ENGINEER, 47 Cedar Street.

TO MANUFACTURERS OF RAILWAY SUPPLIES.

POSITION WANTED as Traveling or Local Agent by a gentleman who has long acted in former capacity for large corporations, and who has a wide acquaintance among railway officials. References unexceptionable. Salary moderate.

Address R, Office AMERICAN ENGINEER AND RAILROAD JOURNAL, 47 Cedar Street, New York.

MAP OF THE UNITED STATES.

A LARGE, handsome map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of 15 cents in postage by P. S. Eustis, General Passenger Agent, Chicago, Burlington & Quincy Railroad, Chicago, Ill.

THE PENNSYLVANIA RAILROAD

is favored with the patronage of the best class of travelers.

Why?

Because, with complete protection by the block-signal, automatic and interlocking switches, and an unsurpassed roadbed, it is the safest.

Because, with a superb service of perfectly appointed trains, it is the most comfortable.

Because, with wise management and unlimited facilities, it is the promptest.

These reasons are heavy, and they tip the balance on the side of the "standard railway of America."

"BODY RESTED, MIND AT EASE."

That is what it is when travelling on the fast trains of the Chicago, Milwaukee & St. Paul Railway; besides there is no chance to "kick," for the accommodations are up to date, the trains keep moving right along and get there on time. These lines thoroughly cover the territory between Chicago, La Crosse, St. Paul, Minneapolis, Aberdeen, Mitchell, Sioux Falls, Sioux City, Yankton, Council Bluffs, Omaha and Northern Michigan. All the principal cities and towns in that territory are reached by the "St. Paul" lines, connecting at St. Paul, Council Bluffs and Omaha with all lines for points in the far west. Write to Geo. H. Heafford, General Passenger and Ticket Agent, Chicago, Ill., for one of their new map time tables and a brochure giving a description of the Compartment Sleeping Cars. Tickets furnished by any coupon ticket agent in the United States and Canada. The finest dining cars in the world are run on the solid vestibuled, electric-lighted and steam-heated trains of the Chicago, Milwaukee & St. Paul Railway.

—SOME SPECIAL FEATURES OF THE—

American Engineer and Railroad Journal

FOR THE PAST SIX MONTHS.

APRIL, Some Facts Relating to Certain Types of Water-Tube Boilers Wrecking Crane, Philadelphia & Reading R. R.; The Cruiser "Cincinnati;" Tests of the Pneumatic Guns; Rapid Transit in Large Cities; The Electric Motor in a Boiler Shop; The Deterioration of Locomotive and Marine Boilers Due to Expansion and the Means of Lessening the same; The Narrow Guage Delusion.

MAY, Method of Determining the Flashing and Burning Points of Combustible Liquids; Electric Motors at the Southwark Foundry & Machine Co.'s Shops; Sand Shed at Hornellsville, New York, Lake Erie and Western Railroad; The Gas Engine; Water-Tube Boilers in the British Navy; Cylinder for Class P Locomotive, Pennsylvania Railroad.

JUNE, Method of Determining Tar and Tar Acids in Wood Preservatives; Coal Storage Plant at Port Richmond; Some Facts Relating to Certain Types of Water-Tube Boilers; Scale Testing Car Philadelphia & Reading R.R.; The Efficiency of the Compound Locomotive; Water-Jet Pile Driving.

JULY, The Steamship "St. Louis;" Some Tests with Fuel Gas; The Master Car Builders' Convention; The Master Mechanics' Convention; Boilers and Vessels of War; Boiler for Class P Locomotive, Pennsylvania Railroad; Air Pumps for U. S. Battleship "Texas;" The International Railway Congress; Method of Taking Cold Test and Chilling Point of Oils and Other Liquids.

AUGUST, Eight-Wheeled Compound Freight Locomotive for the Prussian Railroads; A Piece-Rate System, being a step towards the partial solution of the Labor Question; Hopper Gondola Car, Lehigh Valley Railroad; Third-Class Torpedo Boat for the United States Cruiser "Maine;" Wrecking Car, Central Vermont Railroad; The Down-Draft Furnace for Steam Boilers; The Fuse for the Pneumatic Dynamite Guns; Test of the Richmond Compound Locomotive.

SEPTEMBER, The Laval Steam Turbine; Machine Driving with Electric Motors; The United States Cruisers "Columbia" and "Minneapolis;" New Compound Locomotive for the St. Gothard Railroad; Locomotive Piston Rods; Railway Rolling Stock.

BACK NUMBERS MAY BE PROCURED AT TWENTY-FIVE CENTS EACH.

ADDRESS **M. N. FORNEY, 47 Cedar St., New York.**

F. W. DEVOE & CO., (ESTABLISHED 1852.)

Fulton Street, Cor. William, New York.

FURNISHERS OF

Paints, Coach Colors, Fine Varnishes.

According to Specifications, to

Pennsylvania Railroad Company,
New York Central & Hudson River R.R.,
New York, Lake Erie & Western Ry.,
Del., Lack. & Western Ry.,
and others.

Steam Heating from the Locomotive:
Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,199. **SEWALL COUPLERS** sold 55,617; the standard in U. S. and Canada.

Electric Heaters for Street Cars:
1,103 Car Equipments sold from Aug. 1 to Dec. 1. West End Boston, People's Traction Philadelphia, Nassau Ry. Brooklyn, Union Ry. Providence and Buffalo Railway have recently ordered over 700 Car Equipments.

CONSOLIDATED ALBANY CAR-HEATING CO.

Pope Light Compressed Oil Gas:
Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

Albany, N. Y., 413-423 North Pearl Street:
CHICAGO, 200 WESTERN UNION B'LD'G; Canada, Coaticook, P. Q.—London—Moscow. Specially tested fittings and car lighting repair parts at reasonable prices. Electric Heaters for offices.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.

ESTABLISHED 1824. A SCHOOL OF ENGINEERING. SEND FOR A CATALOGUE.

TRADE VALENTINES MARK.

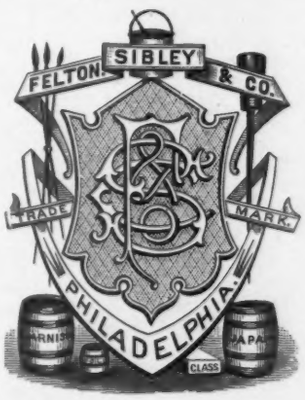
VALENTINE & COMPANY,

MANUFACTURERS OF HIGH GRADE

Coach and Railway Varnishes and Colors,

57 BROADWAY, NEW YORK.

190 Wabash Ave., CHICAGO. *164 Purchase St., BOSTON.* *21 Rue de Lappe, PARIS.*



SUPERFINE COACH and CAR COLORS in Oil and Gold Size Japan.

HIGH GRADE VARNISHES and UNSURPASSED DRYING JAPANS

Smokestack Black

A SPECIALTY.

FELTON, SIBLEY & CO.,

PHILADELPHIA, PA.

PRESSES, DIES, AND OTHER SHEET-METAL TOOLS
FERRACUTE MACHINE CO. BRIDGETON N. JERSEY U.S.A.

"1889" "LITTLE GIANT"
RUE INJECTOR Mfg. Co., PHILA., PA.

Facts Worth-Knowing ABOUT Pressure Regulators (Reducing Valves)

For Railroad, Steamship, and other Service.

44-page Hand-Book mailed free.

FOSTER ENGINEERING CO., NEWARK, N. J.

---

800 IN USE
For Naval and Marine Purposes

The ROBERTS SAFETY WATER TUBE BOILER

SEND FOR HANDSOME ILLUSTRATED CATALOGUE 39 CORTLANDT STREET, N. Y.

Political Reform

BY THE

Representation of Minorities.

By M. N. FORNEY.

The Book is published by the author, and will be sent by mail on receipt of the price, which is $1.50.

47 CEDAR ST., N. Y.

The aim of this book is, first, to describe briefly the evils growing out of the present system of electing by a majority of the votes cast in each district, single members to represent the people in it, in national, State, and municipal legislative assemblies; second, to show how some of these evils would be remedied by giving minorities as well as majorities representation in our legislative bodies; third, to describe how this is done in Illinois by the system of cumulative voting, which was adopted in that State more than twenty years ago for the election of members of its House of Representatives; fourth, to describe the results and workings of that system, and show its advantages and disadvantages; fifth, to indicate how the latter may be obviated; sixth, to describe a method of election which, it is thought, would overcome the difficulties inherent in cumulative voting; seventh, to show how the proposed method of election would lessen many of the political evils from which we are now suffering, and to indicate the reforms which would result therefrom; eighth, to compare some of the different systems which have been proposed for securing minority representation and show their merits and defects; and ninth, to give a bibliography of minority or proportional representation for those who are disposed to give the subject more extended study.

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHERS' DEPARTMENT.

General Notes.

The Clayton Air Compressor Works report the sales of several large air compressors to railroad companies. They are to be used for supplying air for a wide variety of shop purposes.

Locomotives for Russia.—It is reported that the Baldwin Locomotive Works have received an order for 40 locomotives for a Russian railroad, and that they are to be of the heaviest type and be of the Vauclain compound plan, and be adapted to burning oil for fuel.

The Continental Iron Works, Brooklyn, N. Y., are making a number of Fox corrugated furnaces for William B. Pollock & Co., Youngstown, O.; Joseph T. Ryerson & Son, Chicago, Ill.; Heipershausen Brothers, New York; William Cramp & Sons, Neafie & Levy, and Harlan & Hollingsworth.

Grease Extractor.—In the new British battleship *Majestic*, which has recently had her steam trials, a special precaution has been taken to filter the feed water after it passes from the condensers. This is done by means of a special apparatus which extracts all the grease from the water, it having been found that when greasy water finds its way into the boilers it has a very deteriorating effect on the plates.

The Diamond Machine Company of Providence, R. I., have lately received a large order for their patent lever and screw-feed lathe to go to a manual training school in California. They supplied Leland Stanford University with about 25 of these lathes some two years ago. This company is getting several orders for their large surface grinding machine, and also for their automatic knife-grinder.

Steamer Line from Fort Pond Bay to Milford Haven.—The fast train over the Long Island Railroad on October 18 was run especially to show Mr. Thomas Wood, the Chairman of the Milford Haven Dock Company, of England, the proposed terminus for the line of steamers which Mr. Corbin has projected to run between these points, and in connection with the Long Island Railroad, of which he is President. This scheme has been presented to the public quite often, until some of us have grown just a little weary of it. In fact, if the splendid schemes which Mr. Corbin devises and *don't* carry out were brought to a consummation, they would make him one of the greatest projectors of modern times.

"The Engineer," of New York.—Through an oversight we neglected to notice that on August 1 the veteran editor, Mr. Egbert P. Watson, of *The Engineer*, had repurchased all the rights, title, and interest of the Watson-Warren Company in that paper, and that from the date named he would assume all responsibility of its management. The paper is unique in that it represents the personality of its editor, whose pronounced characteristics are reflected in its columns, and always make it interesting reading. Success and long life to the paper and its editor.

The Brady Metal Company will remove its office on November 11 to the American Surety Building, No. 100 Broadway. They have hired a suite of offices, Nos. 18 and 19 on the fourteenth story, where they will be pleased to see their friends and patrons.

In a few months the President and Sales Agent of this Company, Mr. Daniel M. Brady, will have completed a quarter of a century in active railway and manufacturing service. From 1871 to February, 1883, he was connected with the New York Central & Hudson River Railroad at Grand Central Station, and since the date mentioned he has been located at the Boreel Building, 115 Broadway, New York.

Brick Dust Cement.—Attention has been repeatedly called to the fact that brick dust is very generally used in Spanish countries in place of hydraulic cement for building purposes. A correspondent of the *English Mechanic* says that "throughout the East this material appears to have been in use as an ingredient in their notably durable mortars and cements from times unknown." The bricks, he says, are pulverized by a stamp worked by man or woman-power, and is then passed through a sieve. Does any one know of the use of this cheap material—which is obtainable everywhere—in this country, and if so, with what results?

The Dayton Gas-Engine & Manufacturing Company have recently sold one of their high-grade engines to the Stillwell-Bierce, Smith-Vaile Manufacturing Company of Dayton, O., to be shipped to New Orleans, where it is to be used to run an ice plant manufactured and set up by the latter company. This is only another field where gas-engines can prove their economy and adaptability.

Smith's Locomotive Boiler Washer.—Mr. D. O. Smith, of Whistler, Ala., whose boiler-cleaning device we illustrated on p. 431 of our September issue, writes that the illustration and description of it which we gave is a little misleading, as it leaves the impression that it is a fixture or permanent attachment to each engine. It is, in fact, detachable, and is applied to boilers only when they are to be washed out, and any number of boilers can be washed with one of these devices. He says, further, that "boilers can be more perfectly washed and kept clean with this appliance than they can with the ordinary means which are used, and this saves coal and reduces the cost of repairing flues, boiler-sheets," etc.

A Large Cargo.—The White Star new cargo-boat *Georgic*, which arrived in the Mersey on Saturday forenoon, brought what is described as "the biggest cargo that ever left New York." The *Georgic* is the largest cargo-boat afloat, and she certainly brought a vast quantity of merchandise. On her freight list are 750 cattle, 9,000 sheep, 3,000 quarters beef, 136,000 bushels wheat, 90,000 bushels corn, 550 bales cotton, 2,000 sacks flour, 1,800 bags of oilcake, 1,800 cases, 1,700 boxes bacon, 300 barrels and tins of provisions, 9,000 packages lard, 3,900 barrels resin, 700 barrels glucose, 1,000 cases of canned goods, 300 packages soap, 400 barrels wax, 300 barrels bark extract, 1,000 barrels lubricating oil, 100 tons wood, 3,000 packages acetate of lime, 150 barrels oxide of zinc, and 10,000 packages of cooperage stock.—*London Times.*

Williams' Locomotive Valve-Setting Device.—The Q. & C. Company, of Chicago, inform us that they have made arrangements for the manufacture of this appliance, and are now prepared to furnish it to railroad companies or other parties who use locomotives.

The object of the lost-motion adjusting machine is to put the valve-gearing while setting valves as near as possible under the same strain that it is put in while the engine is working steam. With a heavy pressure of steam on the valves, the lost motion is first held to one side and then to the other of the different bearings, as the valve is pushed and pulled over the seat. The lost-motion adjuster artificially takes the place of steam, and enables the valve setter to set the valves accurately, and know just how the engine is going to work with steam, which is practically impossible to do without artificial means of overcoming this difference.

More Fast Runs.—Records nowadays seem to be made of very fragile material, as we hear almost daily that some of them have been broken. On October 1 a train consisting of two sleepers and baggage car was sent out of Buffalo on the Michigan Central at 2.11 A.M., and reached Chicago at 10.34 P.M., a distance of 511 miles, making that distance, it is said, in nine hours and 45 minutes, or at the rate of a little more than 61 miles per hour including stops; but, as usual, the record published is a little mixed It is said that between Fargo and Charing Cross it ran at the rate of 72½ miles per hour.

On October 5 a train—number of cars not stated—left East Buffalo, on the Delaware, Lackawanna & Western Railroad, at 8.47 A.M., and, it is said, arrived in Hoboken at 4.19 P.M., and made the run of 407 miles in 452 minutes. But again the published record is not clear. It is said that at one place it ran 6½ miles in four minutes, or at the rate of 99½ miles per hour, and that it ran from Buffalo to Binghampton, 199 miles, in 175 minutes, or at the rate of over 68 miles per hour.

On October 18 a special train left Long Island City for Fort Pond Bay, and, it is reported, "covered" the distance of 110 miles in 109 minutes; but there were "vexatious delays."

All these fast trains seem to carry an Ananias along with them, and furnish evidence of the fact that ther are some subjects—such as the height of a thermometer on a hot day, the size of fish which people catch, and the speed of horses and trains—about which average human nature is not reliable.

An Expensive Stop.—It is reported that half a million dollars is what the Great Western Railway of England has just had to pay to free itself from the obligation to stop every

No Air Valves or Pumps,
No Leaking or Freezing,
No Pipes, Rusted Chain or Cranks,

Operated from Grade or Tower House,
Guaranteed Absolutely for a Period of Years,
A Practical Summer and Winter Gate.

THE DAYTON RAILWAY CROSSING GATE.

ERECTED ON TRIAL, SUBJECT TO ACCEPTANCE AND APPROVAL.

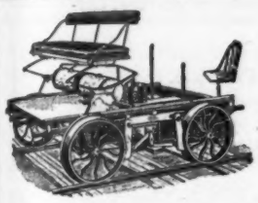
ESTIMATES FURNISHED.

THE CRAIG-REYNOLDS FOUNDRY CO.,

DAYTON, OHIO.

EASTERN AGENT,
ERNEST S. CRONISE, Room 33, 37 Broad St., New York.

WESTERN AGENT,
JOHN McKINNON, 374 The Rookery Bldg., Chicago, Ill.



Kalamazoo R. R. Velocipede and Car Co.,

KALAMAZOO, MICH., U. S. A.

Gasoline Motor Inspection Car.

It has no fire exposed.
It is free from any possibility of explosion.
It is ready to start at a moment's notice.

PERFECTLY RELIABLE.

MANUFACTURERS OF

STEEL WHEEL HAND CARS, STEEL VELOCIPEDE CARS, STEEL SURFACE CATTLE GUARDS, and a New RAILWAY TRICYCLE, constructed with ball bearings and throughout similar to a road bicycle.

Send for Catalogue and mention this Journal.

—THE—

BETHLEHEM

IRON COMPANY,

SOUTH BETHLEHEM, PENNA.

STEEL + RAILS,

BILLETS AND MUCK BAR,

STEEL FORGINGS.

HOLLOW SHAFTING, CRANKS, ROLLS, GUNS AND ARMOR,

Rough, Machined or Finished, Fluid Compressed, Hydraulic Forged

NEW YORK OFFICE, - - 80 BROADWAY.

Philadelphia Office: 421 Chestnut Street.

FISHER & PORTER, 1025 Monadnock Block, Chicago, Western Sales Agents.

JOHN A. WILSON, *Civil Engineer.* JOSEPH M. WILSON, *Civil Engineer and Architect.* HENRY W. WILSON *Civil Engineer.*

WILSON BROTHERS & CO.,

Civil Engineers, Architects and Consulting Engineers.

CHAS. G. DARRACH, *Civil & Hydraulic Eng'r.* DREXEL BUILDING: Cor. Chestnut and Fifth Streets, HENRY A. MACOMB, *Architect.*

PHILADELPHIA, PA.

SOOYSMITH & CO.,

Incorporated,

CONTRACTING ENGINEERS,

MILLS BUILDING, 15 BROAD ST., NEW YORK.

PASCHKE, VAN HORNE & KELLEY,

CIVIL ENGINEERS

Rooms 716, 717 & 718 Havemeyer Building, New York City.

Cable Address: "Paskel." A. B. C. or Anglo-American Code.

All kinds of Surveys carefully made. Plans and Specifications for Railroads, Water Works, Water Power, Sewerage, and their superintendence Topographical Relief Models made. Examinations and Reports upon all Public Enterprises and Properties in Spanish-American Countries.

Correspondence in English, Spanish, German and French.

LOUIS P. EVANS,

Engineer and Contractor,

Designs furnished if required. Railroad Bridges and Trestle Work. Mill and Factory Buildings, etc.

S. E. Corner 4th and Walnut Sts., Philadelphia, Pa.

NEW YORK CENTRAL & HUDSON RIVER R. R.

The Great Four-Track Trunk Line of America.

Wagner Palace Sleeping and Drawing-Room Cars on all Through Trains.

All through trains arrive at and depart from Grand Central Station, Fourth Ave. and 42d Street, New York, the very centre of the city.

John M. Toucey, Gen'l Manager.
Geo. H. Daniels, Gen'l Passenger Agent.

The Direct Line between New York AND Niagara Falls.

GOOD PATENTS

PROCURED IN ALL COUNTRIES.

GRANT INSURED.

30 YEARS' PRACTICE.

Reliable, prompt service. Fair charges. Advice as to patentability. Pamphlet and References *free*. Write to

CHAS. J. GOOCH, Patent Attorney, WASHINGTON, D. C.

MACHINERY — CUTS — A SPECIALTY.

JAMES S. CONANT & CO.

Engravers on Wood

3 Franklin St., BOSTON.

GEO. L. FOWLER,

Consulting Mechanical Engineer,

53 BROADWAY, NEW YORK.

ALFRED A. HUNTING,

Consulting and Mechanical Engineer,

Plans of Steam Plants for Mills and Street Railways a Specialty.

618 John Hancock Building, Boston, Mass.

PENNSYLVANIA RAILROAD.

The Standard Railroad of America.

The Only Four-track Line Leading Out of New York City.

Connecting all the principal cities on the Atlantic Coast with those in the Mississippi Valley and on the Great Lakes. Through trains with Pullman Vestibule, Buffet, Sleeping and Dining Cars attached, between New York, Philadelphia, Washington and Baltimore and Chicago, St. Louis, Cincinnati and Louisville.

S. M. PREVOST, General Manager. J. R. WOOD, General Passenger Agent.

WM. A. ROSENBAUM,

ELECTRICAL EXPERT AND SOLICITOR OF PATENTS,

Formerly Manager of, now successor to, the Patent Business heretofore conducted by "The Electrical World."

Times Building, New York.

train at Swindon Station for 10 minutes. In 1841, before the road had reached Bristol, it made an agreement for 99 years with a firm of builders to hold every train carrying passengers, "not being sent express or for special purposes, for a reasonable period of about 10 minutes," at Swindon, in consideration of the erection of suitable refreshment rooms, for which a rent of a penny a year was to be paid. The railroad soon found out the inconvenience of the arrangement, and tried to break it. The courts in 1846 and 1872 held that "express" did not mean in the contract what is now meant by an express train; but the price asked for the annulment of the concession was always more than the company was willing to pay. After a fight of over 50 years it has been driven by the competition of other roads to buy out its opponents, and the 10-minute stop of fast expresses at Swindon is now a thing of the past.

Major Pangborn among the Kangaroos.—A copy of the *New South Wales Railway Budget* contains a report of an interview with the Major, and an account of the excursions of the "American Railroad Transport Commission" over the railroads of Western and South Australia, Victoria, Tasmania, New Zealand, and New South Wales, and his opinion of those lines, which may be summed up in his concluding remarks, in which he says:

"As far as the general aspect of the case is concerned, I think New South Wales is over-supplied with railways. In fact, without a single exception every colony in Australasia has done exactly as America did, and overbuilt. Developing or feeding lines have been constructed where the work of feeding the trunks should have been left to mule trains. Without exception, there is not a single railway system in Australasia that, had it been in private hands, would not have been bankrupt years ago. That is to say, had these systems been compelled to depend upon themselves for their credit, and upon their unaided earnings to pay their fixed charges, managed as they have been, they could not have been kept out of the receiver's hands."

Thorneycroft Water-Tube Boiler Agency.—Mr. John Platt, whose office is in the Fidelity Building, Nos. 97–103 Cedar Street, has been appointed by Messrs. John J. Thorneycroft & Co., of Chiswick, London, England, as their agent in this country. He writes: "I particularly intend to develop and push their well-known water-tube boilers in this country, both for marine and land service. I am authorized to grant licenses for the construction and use of boilers under their patents.

"The patents are on the 'Daring' type of boiler, a new yacht boiler in which the return tubes are used as fire-bars, also their separator and feed-water regulator.

"This feed-water regulator is being used extensively in England in electric-light stations with all kinds of water-tube boilers, and is found to be very efficient.

"In a test of this boiler, made by Dr. A. B. W. Kennedy, F.R.S., than whom there is no greater authority living, the remarkable efficiency of 87 per cent. was attained. Curiously enough, this same efficiency was also found by Professor Capper in a model boiler fired with gas. This boiler we expect to have here in a short time, and in it the very perfect circulation can be watched through glass ends to the drum. At the present time they are making for me a 12 hours' test, and this we hope to be able to hand you in a short time."

Free Labor Congress.—A National Free Labor Congress, which commenced on October 7, was held in Newcastle-on-Tyne. In the report which was presented it is said:

"The advent of the new socialistic trade-unionism was marked by deeds of violence, both in London and the great industrial centres, which disgraced the name of civilized labor. Men went in fear of their lives when searching for work, and, as in the case of the Albert Dock strike in 1891, the Cardiff strike in 1891, the Leeds gas strike in 1892, and the Hull strike in 1893, scenes of terrorism, burnings, and even attempted murder were the favorite instruments which this new socialistic movement employed. Again, not satisfied with endeavoring to coerce the main body of the working men by their unscrupulous tactics, these New Unionists even claimed a monopoly of the work from the old trade-unionists themselves, and conspired to force employers of labor to act as the collectors for the funds of the new unions, which were then paralyzing industry and ruining many employers."

The report concludes:

"It will be in the future, as in the past, the sole aim and object of the organization to weld together the vast body of the non-union labor of the country into a gigantic co-operation, so as to protect the working classes from the unscrupulous devices of the self-seeking agitators who endeavor to dominate the trade of the country, and in this laudable desire we earnestly bespeak the support of every loyal and patriotic workman."

It is said that 22,680 builders' workmen were enrolled on the books of the association in six months, and employment had been found for 1,991 registered bricklayers, plasterers, carpenters and others.

MAP OF THE UNITED STATES.

A LARGE, handsome map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of 15 cents in postage by P. S. Eustis, General Passenger Agent, Chicago, Burlington & Quincy Railroad, Chicago, Ill.

THE PENNSYLVANIA RAILROAD

is favored with the patronage of the best class of travelers.

Why?

Because, with complete protection by the block-signal, automatic and interlocking switches, and an unsurpassed roadbed, it is the safest.

Because, with a superb service of perfectly appointed trains, it is the most comfortable.

Because, with wise management and unlimited facilities, it is the promptest.

These reasons are heavy, and they tip the balance on the side of the "standard railway of America."

"BODY RESTED, MIND AT EASE."

That is what it is when travelling on the fast trains of the Chicago, Milwaukee & St. Paul Railway; besides there is no chance to "kick," for the accommodations are up to date, the trains keep moving right along and get there on time. These lines thoroughly cover the territory between Chicago, La Crosse, St. Paul, Minneapolis, Aberdeen, Mitchell, Sioux Falls, Sioux City, Yankton, Council Bluffs, Omaha and Northern Michigan. All the principal cities and towns in that territory are reached by the "St. Paul" lines, connecting at St. Paul, Council Bluffs and Omaha with all lines for points in the far west. Write to Geo. H. Heafford, General Passenger and Ticket Agent, Chicago, Ill., for one of their new map time tables and a brochure giving a description of the Compartment Sleeping Cars. Tickets furnished by any coupon ticket agent in the United States and Canada. The finest dining cars in the world are run on the solid vestibuled, electric-lighted and steam-heated trains of the Chicago, Milwaukee & St. Paul Railway.

BALLOON MANUFACTURE.

Balloons of every description. Silk, Gold Beaters' Skin, etc. Military Balloons, Captive Balloons for Exhibitions, Captive Advertising Balloons, etc.

Inventions worked out from plans on large scale or model. Grotesque Figure, Animal and Toy Balloons in Gold Beaters' Skin.

Scientific ascents conducted. Price lists on application.

AUGUSTE E. GAUDRON, Aeronaut and Balloon Manufacturer,
7 Victor Road, London, N., England.

PURE AIR IN PASSENGER CARS.

Without Dust, Draft or Cinders.

NO ADDITIONAL COST ON NEW CARS.
SMALL COST ON OLD CARS.
PERFECT VENTILATION.

Send for Catalogue.

Palmer Ventilator Co.,
Bowdoin St., BOSTON, MASS

F. W. DEVOE & CO., (ESTABLISHED 1852.)
Fulton Street, Cor. William, New York.

FURNISHERS OF

Paints, Coach Colors, Fine Varnishes.

According to Specifications, to

Pennsylvania Railroad Company,
New York Central & Hudson River R.R.,
New York, Lake Erie & Western Ry.,
Del., Lack. & Western Ry.,
and others.

Steam Heating from the Locomotive:
Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,199. **SEWALL COUPLERS** sold 55,617; the standard in U. S. and Canada.

Electric Heaters for Street Cars:
1,103 Car Equipments sold from Aug. 1 to Dec. 1. West End Boston, People's Traction Philadelphia, Nassau Ry. Brooklyn, Union Ry. Providence and Buffalo Railway have recently ordered over 700 Car Equipments.

CONSOLIDATED ALBANY CAR-HEATING CO.

Pope Light Compressed Oil Gas:
Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

Albany, N. Y., 413-423 North Pearl Street:
CHICAGO, 200 WESTERN UNION B'LD'G; Canada, Coaticook, P. Q.—London—Moscow. Specially tested fittings and car lighting repair parts at reasonable prices. Electric Heaters for offices.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.
ESTABLISHED 1824. A SCHOOL OF ENGINEERING. SEND FOR A CATALOGUE.

TRADE VALENTINES MARK.

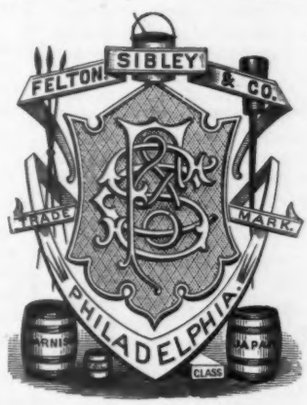
VALENTINE & COMPANY,

MANUFACTURERS OF HIGH GRADE

Coach and Railway Varnishes and Colors,

57 BROADWAY, NEW YORK.

Wabash Ave., CHICAGO. *164 Purchase St., BOSTON.* *21 Rue de Lappe, PARIS.*



SUPERFINE COACH and CAR COLORS in Oil and Gold Size Japan.

HIGH GRADE VARNISHES and UNSURPASSED DRYING JAPANS

Smokestack Black

A SPECIALTY.

FELTON, SIBLEY & CO.,

PHILADELPHIA, PA.

PRESSES, DIES, AND OTHER SHEET-METAL TOOLS
FERRACUTE MACHINE CO. BRIDGETON, N. JERSEY, U.S.A.

"1889" RUE INJECTOR
"LITTLE GIANT"
Mfg. Co., PHILA., PA.

Facts Worth-Knowing ABOUT Pressure Regulators
For Railroad, Steamship, and other Service.
(Reducing Valves)
44-page Hand-Book mailed free.
FOSTER ENGINEERING CO.,
NEWARK, N. J.

200 IN USE
For Naval and Marine Purposes

The ROBERTS SAFETY WATER TUBE BOILER

SEND FOR HANDSOME ILLUSTRATED CATALOGUE 39 CORTLANDT STREET, N. Y.

Political Reform
BY THE
Representation of Minorities.
By M. N. FORNEY.
The Book is published by the author, and will be sent by mail on receipt of the price, which is $1.50.
47 CEDAR ST., N. Y.

The aim of this book is, first, to describe briefly the evils growing out of the present system of electing by a majority of the votes cast in each district, single members to represent the people in it, in national, State, and municipal legislative assemblies; second, to show how some of these evils would be remedied by giving minorities as well as majorities representation in our legislative bodies; third, to describe how this is done in Illinois by the system of cumulative voting, which was adopted in that State more than twenty years ago for the election of members of its House of Representatives; fourth, to describe the results and workings of that system, and show its advantages and disadvantages; fifth, to indicate how the latter may be obviated; sixth, to describe a method of election which, it is thought, would overcome the difficulties inherent in cumulative voting; seventh, to show how the proposed method of election would lessen many of the political evils from which we are now suffering, and to indicate the reforms which would result therefrom; eighth, to compare some of the different systems which have been proposed for securing minority representation and show their merits and defects; and ninth, to give a bibliography of minority or proportional representation for those who are disposed to give the subject more extended study.

AMERICAN ENGINEER AND RAILROAD JOURNAL.
PUBLISHERS' DEPARTMENT.

ATLANTA WORLD'S FAIR.

General Passenger Agent D. G. Edwards, of the Cincinnati, Hamilton & Dayton Railway, returned yesterday from Atlanta, says the Cincinnati *Commercial Gazette*, of 21st inst. He talked enthusiastically of the Exposition, which he said is the biggest thing this country has ever seen outside of the Columbian Fair.

"The displays are perfection," said Mr. Edwards. "The Government exhibit is not so large as it was at Chicago, but is well planned and is conveniently arranged. The fishery exhibit is unique, and an attractive feature. The arrangement of the buildings is something to which nature has lent a valuable hand. The Exposition grounds lie in a natural amphitheatre. The terraces afford visitors opportunities for splendid views. For instance, one building may be situated 50 ft. above another building in another part of the grounds. Standing on a terrace, you can look over what is below you with a feeling of pleasure and satisfaction. The electrical fountain is not yet in order, but the arrangement of other fountains is very interesting. The exhibits of products and manufactured articles reflect credit on the exhibitors and the manufacturers, who will be well advertised. I saw the Cotton Exhibition in New Orleans. It cannot be compared with what you see at Atlanta. One thing impressed me greatly—the people of Atlanta do not seem to be bent on getting all the money they can out of the visitors. The arrangement and disposition of the various committees have been carefully planned. The Public Comfort Committee is something which makes every stranger feel that he is in the hands of his friends. By a system of registration, people who are looking for hotel and boarding-house accommodations feel assured that they will be looked after properly. A room, when once set aside, is held until further orders are given. People of Atlanta do not give you the impression that they are straining themselves to entertain you. There is that Southern hospitality which characterizes the people and the city, and wherever you go, either on the grounds of the Exposition or about the city, you are impressed with the idea that the citizens are endeavoring to spend money to entertain you. Of course you have to spend some yourself, but you do it cheerfully, for you feel that you are at home. I think the criticisms of the 10-cent street-car fare charged for carrying passengers to the Exposition unfair. I looked into the matter. The street railway people have undoubtedly spent a great deal of money. The equipment is far beyond what is necessary in ordinary times; and I hardly think the company would be justly remunerated with a five-cent fare. The street cars are well equipped, and there is no crowding. There are plenty of cars.

"The ride is about five or six miles. The Southern Railway Company has spent an enormous lot of money, and is taking care of its patrons in fine shape. The trains leave for the Exposition every five minutes. You take them at the Union Depot in Atlanta, and the run out to the grounds requires seven or eight minutes. This is good time. The cars are arranged like those on the Illinois Central during the World's Fair—are clean and inviting. The hotels are not exorbitant in their charges. You are not held up by the hackmen as you were at Chicago. The hotels run free omnibuses for their patrons, just as they do at ordinary times. I was surprised to find this state of things. *Cafés* do not overcharge you. The prices are stiff, it is true, but there is no robbery. You can go to Atlanta without any preparation and be assured you will find hotel or good boarding-house accommodations. It is not necessary now to make arrangements in advance when you desire to spend three or four days in seeing the Exposition. The cotton crop of the South has not yet been picked, consequently the local patronage of the Exposition is not so heavy. November will be the great month, for then the people of the South will flock to Atlanta in large numbers. The Midway Plaisance of the Exposition is similar to that of Chicago. I was told that the receipts were good. Any one can spend three or four days and see a good deal of the Exposition, and at the same time get a fair idea of the city of Atlanta. The Piedmont Club House is situated so that from the club house you can look over and see the point from which Sherman got his first glimpse of the city of Atlanta during the Rebellion. Historical incidents are called to mind frequently."

General Notes.

The Diamond Machine Company are to make an exhibit of their ball bearing grinder and other machinery for the use of bicycle manufacturers at the Stanley Show, to be held in London, England, this month.

The New York, New Haven & Hartford Railroad Company, New Haven, Conn., have recently added two more automatic railways of the Hunt type (C. W. Hunt Company, New York City, manufacturers) to their already complete system.

"The Savannah Line News."—The Ocean Steamship Company of Savannah have commenced the publication of a monthly paper of the name given in the heading. It is to appear in the interests of the Ocean Steamship Company and the New England & Savannah Steamship Company, and incidentally to inform the travelling public of various points of interest to be reached by these lines. The paper gives information regarding hotels both North and South, and the first number is naturally replete with references to the Atlanta Exposition.

Wire Guns.—According to the New York *Evening Post*, Mr. Norman Wiard, of wire-wound gun fame, has recently proposed to the U. S. Board of Fortifications:

First, that they should make an allotment for the completion of the Reading 12-in. gun, which is an old Rodman smooth bore, to be converted into a rifle by his system and nearly finished.

Next he offered to take the big 20-in. smooth-bore cast-iron Rodman gun, just removed as obsolete from the earthworks at Fort Lafayette, New York Harbor, and convert this into a 20-in. rifle. As the largest rifle in any service is 16-in. calibre, this would be the greatest rifle ever made. The 16-in. guns have all failed, but Mr. Wiard asserted to the Board that this 20-in. rifle would stand extremely rapid firing, endure at least 100 rounds in 10 hours, and throw a shell weighing a ton with an energy far surpassing any shot on record.

The last proposition is to build an all-steel high-power 16-in. rifle, which he guarantees to excel in endurance and performance any service gun of like size in the world, and to possess the remarkable property of becoming stronger with every shot fired from it. The last property is to be secured by some peculiarity of construction that is not yet fully disclosed.

The Board has taken the propositions under consideration.

Rotary Snow Shovels in Europe.—European railways are commencing to use rotary snow shovels, which have proved a success in America for so long. The Gesellschaft für Verwerthung von Erfindungen im Eisenbahnwesen is building at Görlitz, Prussia, a very powerful machine for Russia, and has furnished one for the Prussian State railways and two for the Hungarian State roads. These machines are built under the patents of Theodore Scheffler, of Paterson, N. J., and Paul Kurth, of Görlitz. The wheel may be raised to clear switches and the like, and the steam is supplied from the locomotive by a flexible spiral copper pipe; a similar pipe conveying the exhaust into the stack of the locomotive. Mr. Robert Grimshaw is consulting engineer for the above-named company.

Mr. L. M. Moyes, the patentee and manufacturer of the "Combine" water-tube boilers, has leased the factory premises 1434–1436 Randolph Street, Philadelphia, Pa., where the manufacturing and assembling of his boiler will be carried on, and where the general offices will be maintained. He is at present arranging for the incorporating of his business with a view to the developing of the manufacturing department. The "Combine" boiler is in successful operation, and a series of tests have shown gratifying results. Boiler plants are now being erected at various points; among others there is one of 200 H.P. for Thomas Kelley, Philadelphia, Pa.; 100 H.P. for St. Ann's Catholic Schools, Philadelphia, Pa.; 125 H.P. for the Marietta Electric Light Company, Marietta, Pa.; 130 H.P. for the Washington Agricultural College, Pullman, Wash. A second edition of the catalogue on "Steam Boilers" will soon be issued, and will be sent on application.

Increase of Accidents in Factories.—It is said that there has been a remarkable increase of reported accidents in factories in England during the last year. This is attributed in part to increased activity and vigilance on the part of the factory inspectors, and the inquiry is suggested whether increased inspection does not diminish the carefulness both of employers and employed.

At the International Congress on Industrial Accidents at Milan last year it was stated that in Germany one of the causes of the increase of accidents was the carelessness of the work-

Air Valves or Pumps,
No Leaking or Freezing,
No Pipes, Rusted Chain or Cranks,

Operated from Grade or Tower House,
Guaranteed Absolutely for a Period of Years,
A Practical Summer and Winter Gate.

THE DAYTON RAILWAY CROSSING GATE.

ERECTED ON TRIAL, SUBJECT TO ACCEPTANCE AND APPROVAL.

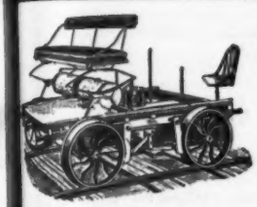
ESTIMATES FURNISHED.

THE CRAIG-REYNOLDS FOUNDRY CO.,

DAYTON, OHIO.

EASTERN AGENT,
NEST S. CRONISE, Room 33, 37 Broad St., New York.

WESTERN AGENT,
JOHN McKINNON, 374 The Rookery Bldg., Chicago, Ill.



Kalamazoo R. R. Velocipede and Car Co.,

KALAMAZOO, MICH., U. S. A.

Gasoline Motor Inspection Car.

It has no fire exposed.
It is free from any possibility of explosion.
It is ready to start at a moment's notice.

PERFECTLY RELIABLE.

MANUFACTURERS OF

STEEL WHEEL HAND CARS, STEEL VELOCIPEDE CARS, STEEL SURFACE CATTLE GUARDS, and a New RAILWAY TRICYCLE, constructed with ball bearings and throughout similar to a road bicycle.

Send for Catalogue and mention this Journal.

—THE—

BETHLEHEM

IRON COMPANY,

SOUTH BETHLEHEM, PENNA.

STEEL + RAILS,

BILLETS AND MUCK BAR,

STEEL FORGINGS.

HOLLOW SHAFTING, CRANKS, ROLLS, GUNS AND ARMOR,

Rough, Machined or Finished, Fluid Compressed, Hydraulic Forged.

NEW YORK OFFICE, - - 80 BROADWAY.

Philadelphia Office: 421 Chestnut Street.

FISHER & PORTER, 1026 Monadnock Block, Chicago, Western Sales Agents.

JOHN A. WILSON, *Civil Engineer.* JOSEPH M. WILSON, *Civil Engineer and Architect.* HENRY W. WILSON *Civil Engineer.*

WILSON BROTHERS & CO.,

Civil Engineers, Architects and Consulting Engineers.

CHAS. G. DARRACH, *Civil & Hydraulic Eng'r.* DREXEL BUILDING: Cor. Chestnut and Fifth Streets, HENRY A. MACOMB, *Architect.*

PHILADELPHIA, PA.

SOOYSMITH & CO.,

Incorporated,

CONTRACTING ENGINEERS,

MILLS BUILDING, 15 BROAD ST., NEW YORK.

PASCHKE, VAN HORNE & KELLEY,

CIVIL ENGINEERS

Rooms 716, 717 & 718 Havemeyer Building, New York City.

Cable Address: "Paskel." A. B. C. or Anglo-American Code.

All kinds of Surveys carefully made. Plans and Specifications for Railroads, Water Works, Water Power, Sewerage, and their superintendence Topographical Relief Models made. Examinations and Reports upon all Public Enterprises and Properties in Spanish-American Countries.

Correspondence in English, Spanish, German and French.

LOUIS P. EVANS,

Engineer and Contractor,

Designs furnished if required. Railroad Bridges and Trestle Work. Mill and Factory Buildings, etc.

S. E. Corner 4th and Walnut Sts., Philadelphia, Pa.

EW YORK CENTRAL & HUDSON RIVER R. R.

The Great Four-Track Trunk Line of America.

Wagner Palace Sleeping and Drawing-Room Cars on all Through Trains.

All through trains arrive at and depart from Grand Central Station, Fourth Ave. and 42d Street, New York, the very centre of the city.

n M. Toucey, Gen'l Manager.
. H. Daniels, Gen'l Passenger Agent.

The Direct Line between New York AND Niagara Falls.

GOOD PATENTS

PROCURED IN ALL COUNTRIES.

GRANT INSURED.

30 YEARS' PRACTICE.

Reliable, prompt service. Fair charges. Advice as to patentability. Pamphlet and References *free*. Write to

CHAS. J. GOOCH, Patent Attorney, WASHINGTON, D. C.

MACHINERY — CUTS — A SPECIALTY.

JAMES S. CONANT & CO.

Engravers on Wood

3 Franklin St., BOSTON.

GEO. L. FOWLER,

Consulting Mechanical Engineer,

53 BROADWAY, NEW YORK.

PENNSYLVANIA RAILROAD.

The Standard Railroad of America.

The Only Four-track Line Leading Out of New York City.

Connecting all the principal cities on the Atlantic Coast with those in the Mississippi Valley and on the Great Lakes. Through trains with Pullman Vestibule, Buffet, Sleeping and Dining Cars attached, between New York, Philadelphia, Washington and Baltimore and Chicago, St. Louis, Cincinnati and Louisville.

S. M. PREVOST, General Manager. J. R. WOOD, General Passenger Agent.

ALFRED A. HUNTING,

Consulting and Mechanical Engineer,

Plans of Steam Plants for Mills and Street Railways a Specialty.

618 John Hancock Building, Boston, Mass.

WM. A. ROSENBAUM,

ELECTRICAL EXPERT AND SOLICITOR OF PATENTS,

Formerly Manager of, now successor to, the Patent Business heretofore conducted by "The Electrical World."

Times Building, New York.

ing man, who is beginning to rely on the State to do everything for him, and the opinion has been more than once expressed that the State inspection of mines can be pushed to a point at which it would diminish the sense of responsibility of the managers. This is a question which touches the principle at issue between the advocates of State interference and those who believe in self-help and self-reliance.

The Trial of the "Katahdin."—The harbor defence ram *Katahdin*, which has been recently completed at the Bath Iron Works, and which was illustrated and described in the AMERICAN ENGINEER for March, 1893, was subjected to her official trial trip on October 31. The course was in Long Island Sound, near New London, Conn., and was 17 miles long. The run out was made in 1 hour 5 minutes and 32 seconds, and the return trip over the same course in 1 hour, 44 seconds, making a total, for the 34 miles, of 2 hours, 6 minutes and 16 seconds. This is the actual elapsed time between the mark buoys. On the outward trip the wind was light, but in favor of the ram, while the tide was running from a knot to a knot and a half against her. By the time that she had turned the wind had freshened considerably, and was dead in her teeth on the return trip, covering the vessel with spray; the tide had also turned, and was again against her. The contract requirements were that the ram should develop a speed of 17 knots. While the apparent time showed that the speed of the vessel had fallen below the contract requirements, it was expected at the time that the tidal allowances would bring her record up to and above those requirements. This was not the case, however, as it was found that, after the allowances had been made, her speed was only 16.13 knots. Unfortunately for the builders, there is an iron-clad clause in the contract that provides for the rejection of the vessel in case she fails to meet the 17-knot requirement as to speed. As it stands now, it seems probable that the vessel will be rejected unless a compromise is effected or such changes can be made in the machinery as to secure the contract speed at a fresh trial.

Classes on English Railroads.—In his speech to the share holders, the Chairman of the Cambrian Railway Company recently called attention to the constant diminution of first-class passenger traffic on that line, and reported that for the preceding half year they had carried 3,304 first class passengers less than in the previous corresponding period. In commenting thereon, he said, "The more I come to think this question out, the more I am convinced that the companies ought to seriously consider the desirability of only having one class."

To this suggestion an irate Britisher replies in the national happy hunting-ground, the *Times*:

"If railway directors and managers would first educate the travellers in third-class to be decent and respectable in their behavior and to dress cleanly and keep perfectly sober—I am speaking, of course, about some only of third-class passengers—then one class carriage might suffice; but so long as one is subject to the worst of men and women, to bad and disgusting smells from fish and other hawkers, to be compelled to hear coarse language, or be subject to rowdyism or boisterous conduct, so long will two classes be necessary; but it should be at a price that should attract passengers to travel first, and not, as in many cases at present, to most passengers a prohibitive rate."

His suggestion is that the cause of the decline of first-class travel is the excessive charges made by the railway companies for first-class fares, which are about double what is charged for third-class. He defends the rights and privileges of the people who value quiet and cleanliness thus:

"It is a matter of observation with me that, while third-class passengers have had the greatest benefits and advantages conceded to them, and have ever been made much of, the first-class passenger has been more or less neglected and treated with indifference, and forced by the companies to travel in a class he would much prefer not to on account of the heavy excess of first over third-class fares."

MAP OF THE UNITED STATES.

A LARGE, handsome map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of 15 cents in postage by P. S. Eustis, General Passenger Agent, Chicago, Burlington & Quincy Railroad, Chicago, Ill.

THE PENNSYLVANIA RAILROAD

is favored with the patronage of the best class of travelers.

Why?

Because, with complete protection by the block-signal, automatic and interlocking switches, and an unsurpassed roadbed, it is the safest.

Because, with a superb service of perfectly appointed trains, it is the most comfortable.

Because, with wise management and unlimited facilities, it is the promptest.

These reasons are heavy, and they tip the balance on the side of the "standard railway of America."

THERE IS ONLY ONE WAY

To reach the Cotton States and International Exposition, Atlanta, Ga., and that is *via* the Southern Railway, "Piedmont Air Line." This has been fully demonstrated within the past four weeks. To meet the demand of the travelling public, the Southern Railway has been running its vestibuled limited trains in two and three sections. Commencing Sunday, October 6, a third limited train was put on, called the Exposition Flyer, leaving New York 11 o'clock A.M., reaching Atlanta following morning at 10 o'clock. The patronage of this train has been far beyond expectation, and if it continues to increase as it has done in the past week it will require two sections to accommodate the travel. The Southern Railway enjoys terminal facilities at Atlanta, and, in fact, in nearly every Southern city of importance, that no other line has, consequently are prepared to give the travelling public better facilities and accommodations.

"BODY RESTED, MIND AT EASE."

That is what it is when travelling on the fast trains of the Chicago, Milwaukee & St. Paul Railway; besides there is no chance to "kick," for the accommodations are up to date, the trains keep moving right along and get there on time. These lines thoroughly cover the territory between Chicago, La Crosse, St. Paul, Minneapolis, Aberdeen, Mitchell, Sioux Falls, Sioux City, Yankton, Council Bluffs, Omaha and Northern Michigan. All the principal cities and towns in that territory are reached by the "St. Paul" lines, connecting at St. Paul, Council Bluffs and Omaha with all lines for points in the far west. Write to Geo. H. Heafford, General Passenger and Ticket Agent, Chicago, Ill., for one of their new map time tables and a brochure giving a description of the Compartment Sleeping Cars. Tickets furnished by any coupon ticket agent in the United States and Canada. The finest dining cars in the world are run on the solid vestibuled, electric-lighted and steam-heated trains of the Chicago, Milwaukee & St. Paul Railway.

BALLOON MANUFACTURE.

Balloons of every description. Silk, Gold Beaters' Skin, etc. Military Balloons, Captive Balloons for Exhibitions, Captive Advertising Balloons, etc.

Inventions worked out from plans on large scale or model. Grotesque Figure, Animal and Toy Balloons in Gold Beaters' Skin. Scientific ascents conducted. Price lists on application.

AUGUSTE E. GAUDRON, Aeronaut and Balloon Manufacturer,
7 Victor Road, London, N., England.

PURE AIR IN PASSENGER CARS

Without Dust, Draft or Cinders.

NO ADDITIONAL COST ON NEW CARS.
SMALL COST ON OLD CARS.
PERFECT VENTILATION.

Send for Catalogue.

Palmer Ventilator Co.,
Bowdoin St., BOSTON, MASS

F. W. DEVOE & CO., (ESTABLISHED 1852.) Fulton Street, Cor. William, New York.

FURNISHERS OF

Paints, Coach Colors, Fine Varnishes.

cording to Specifications, to

Pennsylvania Railroad Company,
New York Central & Hudson River R.R.,
New York, Lake Erie & Western Ry.,
Del., Lack. & Western Ry.,
and others.

am Heating from the Locomotive:
Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,199. **SEWALL COUPLERS** sold 55,617; the standard in U. S. and Canada.

Electric Heaters for Street Cars:
1,103 Car Equipments sold from Aug. 1 to Dec. 1. West End Boston, People's Traction Philadelphia, Nassau Ry. Brooklyn, Union Ry. Providence and Buffalo Railway have recently ordered over 700 Car Equipments.

CONSOLIDATED ALBANY CAR-HEATING CO.

pe Light Compressed Oil Gas:
Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

Albany, N. Y., 413-423 North Pearl Street:
CHICAGO, 200 WESTERN UNION B'LD'G; Canada, Coaticook, P. Q.—London—Moscow. Specially tested fittings and car lighting repair parts at reasonable prices. Electric Heaters for offices.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.

TABLISHED 1824. A SCHOOL OF ENGINEERING. SEND FOR A CATALOGUE.

TRADE VALENTINES MARK.

VALENTINE & COMPANY,

MANUFACTURERS OF HIGH GRADE

ach and Railway Varnishes and Colors,

57 BROADWAY, NEW YORK.

Wabash Ave., CHICAGO. *164 Purchase St.,* BOSTON. *21 Rue de Lappe,* PARIS.

Non-Corrosive Priming and Finishing Paint

For Engines, Machinery, etc.

This paint being entirely free from acid, will not corrode or rust the iron.

Patent Iron Filler

For Tools, Machinery, Engines, Locomotives, Tenders, Iron Ships, and all Iron Work for Buildings, inside or out.

Pure Oxide Paints

For Bridges and General Construction Work.

Send for sample cards and prices.

FELTON, SIBLEY & CO.,
Philadelphia, Pa.

PRESSES, DIES AND OTHER
SHEET-METAL TOOLS
FERRACUTE MACHINE CO.
BRIDGETON N.J. U.S.A.

RUE "1889" "LITTLE GIANT" INJECTOR
Mfg. Co., PHILA., PA.

American Engineer and Railroad Journal
NOW ISSUED BI-WEEKLY
See Prospectus on page XXIII.
Order direct or through your Newsdealer

Price reduced to
10 cents
Yearly Subscription, $2.50

00 IN USE
or Naval and
larine Purposes

The ROBERTS SAFETY WATER TUBE BOILER

SEND FOR HANDSOME ILLUSTRATED CATALOGUE 39 CORTLANDT STREET, N. Y.

Political Reform

BY THE

epresentation of Minorities.

By M. N. FORNEY.

The Book is published by the author, and will be sent by mail on receipt of the price, which is $1.50.

47 CEDAR ST., N. Y.

The aim of this book is, first, to describe briefly the evils growing out of the present system of electing by a majority of the votes cast in each district, single members to represent the people in it, in national, State, and municipal legislative assemblies; second, to show how some of these evils would be remedied by giving minorities as well as majorities representation in our legislative bodies; third, to describe how this is done in Illinois by the system of cumulative voting, which was adopted in that State more than twenty years ago for the election of members of its House of Representatives; fourth, to describe the results and workings of that system, and show its advantages and disadvantages; fifth, to indicate how the latter may be obviated; sixth, to describe a method of election which, it is thought, would overcome the difficulties inherent in cumulative voting; seventh, to show how the proposed method of election would lessen many of the political evils from which we are now suffering, and to indicate the reforms which would result therefrom; eighth, to compare some of the different systems which have been proposed for securing minority representation and show their merits and defects; and ninth, to give a bibliography of minority or proportional representation for those who are disposed to give the subject more extended study.

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHERS' DEPARTMENT.

General Notes.

"Reminiscences of a Railroad Engineer."—The *Railway World*, of Philadelphia, announces that it will, on November 30, publish the first of a series of articles by W. Hasell Wilson, C.E., with the above title. These ought to be, and doubtless will be, of very great interest to all railroad men and those who are in any way concerned in the development of our railroad system. The articles will appear weekly, and run through about eight numbers.

Riehle Brothers' Testing Machine Company have a 100,000-lb. automatic and autographic testing machine at the International Exposition, Atlanta, Ga. This machine forms a part of the Government exhibit, and is in the Minerals and Forestry Building, where any one interested can see it in operation. Tests are being made upon this machine during the day, and it is attracting considerable attention.

William H. Rau, of Philadelphia, Pa., announces that the half-tone engraving business so long conducted by him has been made the basis for the formation of a stock company entitled the International Engraving and Illustrating Company. He will retain an active interest in the new concern, and all of its work will be done under his personal supervision. The photographic and lantern slide business will be conducted by himself as heretofore at 1324 Chestnut Street.

International Industrial Exhibition of the South African Republic in Johannesburg.—They are to have a great international exposition in South Africa, beginning in April, 1896, and it will remain open six weeks. It is to be arranged in 34 different sections. It is also said that amusements will be provided, and a syndicate of first-class business men will provide side shows for the exhibition. Charles P. de Garmo is the Director-General, whose address is Johannesburg, S. A. R.

Anti-smoke Ordinance.—An anti-smoke ordinance went into effect in Pittsburgh on October 1. Nine inspectors were sent out to collect evidence to be used against those who fail to comply with the provisions of the ordinance. More than 20 per cent. of black or gray smoke from any chimney or stack where bituminous coal is used will be deemed a public nuisance, and for more than three minutes' duration will be punished by a fine of from $10 to $50. There are between 3,000 and 4,000 establishments to be visited in the city limits.

Russian Battleships.—On the two armored ships standing near the New Admiralty, St. Petersburg—the *Admiral Seniavin* and the *Poltava*—the mounting of boilers and engines has been commenced. From the newly designed ships, the coast defence armored ship *General Admiral Apraxin* is under construction on the wooden slip; on the two stone slips are in construction a gunboat and an armored battleship of the type of *Sisoi the Great*. On the other wharf—the Galerny Isle—are designed an armored battleship, *Sebastopol*, and a cruiser of great dimensions, greater than has anywhere yet been constructed.

Electricity to Displace Steam.—It is reported that the managers of both the Illinois Central and the Chicago & Northern Pacific railroads are contemplating the substitution of electricity for steam for the suburban traffic of these lines out of Chicago. It is said that bids have already been secured from builders of electrical appliances for the complete equipment of the Illinois Central system. It is estimated that the entire cost will be from $3,000,000 to $4,000,000. This will include the substitution of electricity for steam as the motive power in the company's car shops at Burnside.

The Newburg Ice Machine & Engine Company has been organized, and has purchased the plant formerly operated by the Whitehill Engine and Pictet Ice Machine Company, in Newburg, N. Y. Mr. Edgar Penny, who for the past twelve years has been connected with the Frick Company of Waynesboro, Pa., has been elected President and General Manager of the new company, and Mr. Robert Whitehill will be the Secretary and Treasurer. The company will continue the manufacture of ice-making and refrigerating machinery and the Whitehill Corliss steam engines, simple and compound.

The Huyett & Smith Manufacturing Company, of Detroit, Mich., announce that on October 12 they transferred all of their interests to the American Blower Company. The personnel remains the same, with the exception of the withdrawal of Mr. W. D. Smith, Vice-President. Mr. Huyett not having been connected with the company for more than ten years, the name is meaningless, and the necessity of a change apparent. This announcement is accompanied by one from the American Blower Company, stating that they will continue the manufacturing of hot blast apparatus, dry kilns, fans, blowers, engines, and all kindred machinery that was carried on by their predecessors, the Huyett & Smith Manufacturing Company.

Sight Test for Railroad Employés.—The Chicago & Alton management has announced that on January 1 a rigid system of eye inspection will be introduced in the transportation department of the road. All the men in the department will have to submit to an examination at least once a year. As compared with normal vision, or 100, the test must show a range of vision for both eyes of $6\frac{8}{10}$. Vision normal in one eye and in the other absent, or not more than $6\frac{8}{10}$, unfits for service. Defects of vision corrected by lenses not permissible, but defects due to age may be thus corrected. Total color blindness unfits for the service. The excessive use of tobacco under certain circumstances is cause for rejection of employés.

New Smoke-consuming Apparatus.—The *English Mechanic* says:

"A smoke-consuming apparatus, the patent of Mr. W. McGlashan, of Leith, was tried successfully recently in Edinburgh. A tank of crude oil is placed above the furnace, and pipes are led from that down to the mouth of the ashpit, thence along the ashpit, passing through the bridge into a chamber. The end of a pipe is fitted with a brass plug, in which is a small needle-hole, through which the oil is forced by gravity. The ordinary door in the ashpit is opened a little to admit air to mix with the oil, which bursts into flame, thus consuming the smoke; hence, instead of the smoke passing along the flues, flame takes its place, which keeps the flues clean, and augments the power of the boiler. There is a regulator for controlling the supply of the oil, which acts when the fire is bright and oil is not required.

The Man for the Occasion.—Not long since Sandow was going from Kansas City to Omaha, and the strong man had occasion to go into the day coach. In passing through the car he was accosted by a tall gentleman, with long side whiskers *à la* Taffy.

"Excuse me, sir," he said, "but are you not Mr. Sandow?"

"Yes," said the strong man.

"You can lift three tons in harness?"

"Yes, sir, that is my record," the Hercules returned.

"You can hold 200 weight at arm's length?"

"Yes."

"And put up 300 lbs. with one arm?"

"Yes."

"And 600 with two?"

"Yes."

"Well, then, would you kindly raise this car window for me?"—*St. Louis Republic.*

Engineering by a Mouse.—"While digging holes for telegraph poles at Byron, Me.," said a Western Union man, "I became interested in watching the ingenuity and perseverance of a mouse. He fell into one of the holes, which was 4½ in. deep and 20 in. across. The first day he ran around the bottom of the hole, trying to find some means of escape, but could not climb out. The second day he settled down to business. He began steadily and systematically to dig a spiral groove round and round the inner surface of the hole, with a uniformly ascending grade. He worked night and day, and as he got further from the bottom, he dug little pockets where he could either lie or sit and rest. Interested witnesses threw in food.

"At the end of two weeks the mouse struck a rock. This puzzled him. For nearly a day he tried to get under, around, or over the obstruction, but without success. With unflinching patience he reversed his spiral and went on tunnelling his way in the opposite direction. At the end of four weeks he reached the top, and probably sped away to enjoy his well-earned freedom. His escape was not seen. When his food was put in in the morning he was near the surface, but at night the work was seen to be complete, and the little engineer, whose pluck and skill had saved his life, had left."

Tall Chimney.—A new chimney has just been completed in Paterson, N. J., for the new Edison electric plant. Between 800,000 and 1,000,000 bricks were used in the structure, which soars into the air a distance of 280 ft., having a diameter of 21 ft. at the bottom and 13 ft. near the top, then spreading out to

Air Valves or Pumps,
No Leaking or Freezing,
No Pipes, Rusted Chain or Cranks,
Operated from Grade or Tower House,
Guaranteed Absolutely for a Period of Years,
A Practical Summer and Winter Gate.

THE DAYTON RAILWAY CROSSING GATE.

ERECTED ON TRIAL, SUBJECT TO ACCEPTANCE AND APPROVAL.

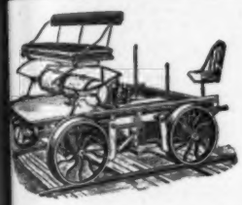
ESTIMATES FURNISHED.

THE CRAIG-REYNOLDS FOUNDRY CO.,

DAYTON, OHIO.

EASTERN AGENT,
ERNEST S. CRONISE, Room 33, 37 Broad St., New York.

WESTERN AGENT,
JOHN McKINNON, 374 The Rookery Bldg., Chicago, Ill.



Kalamazoo R. R. Velocipede and Car Co.,

KALAMAZOO, MICH., U. S. A.

Gasoline Motor Inspection Car.

It has no fire exposed.
It is free from any possibility of explosion.
It is ready to start at a moment's notice.

PERFECTLY RELIABLE.

MANUFACTURERS OF

STEEL WHEEL HAND CARS, STEEL VELOCIPEDE CARS, STEEL SURFACE CATTLE GUARDS, and a New RAILWAY TRICYCLE, constructed with ball bearings and throughout similar to a road bicycle.

Send for Catalogue and mention this Journal.

—THE—

BETHLEHEM

IRON COMPANY,

SOUTH BETHLEHEM, PENNA.

STEEL + RAILS,

BILLETS AND MUCK BAR,

STEEL FORGINGS.

HOLLOW SHAFTING, CRANKS, ROLLS, GUNS AND ARMOR,

Rough, Machined or Finished, Fluid Compressed, Hydraulic Forged

NEW YORK OFFICE, - - 80 BROADWAY.

Philadelphia Office: 421 Chestnut Street.

FISHER & PORTER, 1025 Monadnock Block, Chicago, Western Sales Agents.

JOHN A. WILSON, *Civil Engineer.* JOSEPH M. WILSON, *Civil Engineer and Architect.* HENRY W. WILSON *Civil Engineer.*

WILSON BROTHERS & CO.,

Civil Engineers, Architects and Consulting Engineers.

CHAS. G. DARRACH, *Civil & Hydraulic Eng'r.* DREXEL BUILDING: Cor. Chestnut and Fifth Streets, HENRY A. MACOMB, *Architect.*

PHILADELPHIA, PA.

SOOYSMITH & CO.,

Incorporated,

CONTRACTING ENGINEERS,

MILLS BUILDING, 15 BROAD ST., NEW YORK.

PASCHKE, VAN HORNE & KELLEY,

CIVIL ENGINEERS

Rooms 716, 717 & 718 Havemeyer Building, New York City.
Cable Address: "PaschaLV" A. B. C. or Anglo-American Code.

All kinds of Surveys carefully made. Plans and Specifications for Railroads, Water Works, Water Power, Sewerage, and their superintendence Topographical Relief Models made. Examinations and Reports upon all Public Enterprises and Properties in Spanish-American Countries.

Correspondence in English, Spanish, German and French.

LOUIS P. EVANS,

Engineer and Contractor,

Designs furnished if required. Railroad Bridges and Trestle Work. Mill and Factory Buildings, etc.

S. E. Corner 4th and Walnut Sts., Philadelphia, Pa.

NEW YORK CENTRAL & HUDSON RIVER R. R.

The Great Four-Track Trunk Line of America.

Wagner Palace Sleeping and Drawing-Room Cars on all Through Trains.

All through trains arrive at and depart from Grand Central Station, Fourth Ave. and 42d Street, New York, the very centre of the city.

...n M. Toucey, Gen'l Manager.
...n. H. Daniels, Gen'l Passenger Agent.

The Direct Line between New York AND Niagara Falls.

GOOD PATENTS

PROCURED IN ALL COUNTRIES.

GRANT INSURED.

30 YEARS' PRACTICE.

Reliable, prompt service. Fair charges. Advice as to patentability. Pamphlet and References *free*. Write to

CHAS. J. GOOCH, Patent Attorney, WASHINGTON, D. C.

MACHINERY — CUTS — A SPECIALTY.

JAMES S. CONANT & CO.

Engravers on Wood

3 Franklin St., BOSTON.

GEO. L. FOWLER,

Consulting Mechanical Engineer,

53 BROADWAY, NEW YORK.

PENNSYLVANIA RAILROAD.

The Standard Railroad of America.

The Only Four-track Line Leading Out of New York City.

Connecting all the principal cities on the Atlantic Coast with those in the Mississippi Valley and on the Great Lakes. Through trains with Pullman Vestibule, Buffet, Sleeping and Dining Cars attached, between New York, Philadelphia, Washington and Baltimore and Chicago, St. Louis, Cincinnati and Louisville.

S. M. PREVOST, General Manager. J. R. WOOD, General Passenger Agent.

ALFRED A. HUNTING,

Consulting and Mechanical Engineer,

Plans of Steam Plants for Mills and Street Railways a Specialty.

618 John Hancock Building, Boston, Mass.

WM. A. ROSENBAUM,

ELECTRICAL EXPERT AND SOLICITOR OF PATENTS,

Formerly Manager of, now successor to, the Patent Business heretofore conducted by "The Electrical World."

Times Building, New York.

16 ft. 6 in. The chimney is a double one, having an outside and inside wall. The outside wall is 6 ft. thick at the bottom, tapering to 1 ft. within a few feet of the top, and measuring 3 ft. 2 in. at the top. The inside wall, which runs up 130 ft., is strengthened every 15 ft. by iron bands, to prevent cracking. Between the two walls is an 8-in. cold air space. Where the inside wall ends a set-off protrudes over the cold air space and prevents any soot, loose brick, etc., from falling down and clogging up the space. Near the bottom of the chimney four large holes, one at each of the cardinal points, will permit a free circulation of air. The cap is made of iron, and weighs 6,000 lbs. It is built in eight sections, and was taken to the top by means of the electric hoist. On the three sides of the chimney are three letters "E." From the ground they appear to be painted letters about a foot high, but in reality they are seven feet high, made of iron, and each weighs 400 lbs. These also were put up by means of the electric hoist. On the outside of the structure is a ladder running to the top with an iron rung every 15 in.—*The Sun.*

Glass Water-Gauges.—The *Mechanical World* gives the following directions for taking care of glass water-gauges: "When the water is of a limy character, frequent opportunities should be taken of keeping the passages clear by removing the screw-plug on the bracket and passing a piece of wire through the cocks into the boilers. It is not infrequently found that the bottom bracket has been placed at too low a level, with the result that the water is dangerously low while still showing in the glass, the attendant being under the impression that as long as there is water in the glass the fire-box or furnace crown is covered, and serious danger is thus incurred. Many of the fatal disasters attributable to this cause might have been prevented had the orifice of the lower bracket been above the level of the fire-box crown, so that when the water was in the bottom of the glass there would still have been 3 in. or 4 in. over the crowns. Every boiler attendant should ascertain for himself exactly the depth of water over the crowns when it begins to show in the glass, which can be easily done by leaving the manhole door off when filling the boiler, and when water appears in the glass, measuring the depth of the crowns. When the water-gauge is too low, as above indicated, a ferrule should be placed over the glass to show 3 in. or 4 in. depth of water on the crowns, and this should not be left loose, but secured by filing out the hole in the bottom stuffing-box gland and fitting it tightly in."

The Torpedo-boat Destroyer "Sokol."—This vessel, which was built and engined by Messrs. Yarrow & Co. for the Russian Government, has recently had her official speed trials, and made an average speed of 29.773 knots. The *Times*, in commenting thereon, says of her:

"The *Sokol* is a similar type of vessel to Her Majesty's ships *Havock* and *Hornet*, but is larger than either, being 190 ft. in length. She is also faster to the extent of about three knots, and is the first vessel that has actually attained a speed of 30 knots. Her hull, which in form is somewhat finer than that of the *Havock* or *Hornet*, is constructed of nickel steel, a material of greater strength than that in ordinary use for such vessels, but aluminium has been largely introduced in places where great strength is not of primary importance. The propelling machinery and boilers are very similar to the *Hornet's*, but greatly improved in numerous minor details, which collectively form an important element in the speed attained by this vessel, and it is to these details that the success of the *Sokol* is mainly attributable. The engines, which are capable of developing upward of 4,400 I.H.P., and in the construction of which bronze has been freely used (combining as it does strength with lightness), are of the triple-expansion twin-screw type, and the boilers are Yarrow's patent straight water-tube ones with steel tubes. The armament of the *Sokol* consists of one 12-pdr. quick-firing gun on the steering tower forward and three 6-pdr. similar guns on deck. There are also two swivel deck torpedo-tubes, for firing 16-in. torpedoes over either beam, but no bow tube, as it is now generally discarded. The coal-carrying capacity is 60 tons, which is sufficient to steam across the Atlantic at the rate of 10 knots.

MAP OF THE UNITED STATES.

A LARGE, handsome map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of 15 cents in postage by P. S. Eustis, General Passenger Agent, Chicago, Burlington & Quincy Railroad, Chicago, Ill.

THE PENNSYLVANIA RAILROAD

is favored with the patronage of the best class of travelers. Why?

Because, with complete protection by the block-signal, automatic and interlocking switches, and an unsurpassed roadbed, it is the safest.

Because, with a superb service of perfectly appointed trains, it is the most comfortable.

Because, with wise management and unlimited facilities, it is the promptest.

These reasons are heavy, and they tip the balance on the side of the "standard railway of America."

THE HAPPY HUNTING GROUNDS, ALSO FISHING, OF THE SOUTH.

UNDER the above pleasing title the Southern Railway has in press a beautiful and comprehensive book appertaining to the hunting and fishing of the States through which that system extends.

This, indeed, comprises nearly the entire South, including Virginia, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee and Kentucky, as throughout these States the Southern Railway has its own lines.

The book is written in the happiest style of Mr. William Bruce Leffingwell, of Chicago, and the illustrations are ample and are especially prepared for this particular volume.

This is the first time that such a publication has been attempted, exhibiting in such an attractive manner the almost innumerable resorts for sportsmen in the South.

The publication was issued prior to November 1, 1895, and can be obtained through any of the agents of the Southern Railway system.

"BODY RESTED, MIND AT EASE."

That is what it is when travelling on the fast trains of the Chicago, Milwaukee & St. Paul Railway; besides there is no chance to "kick," for the accommodations are up to date, the trains keep moving right along and get there on time. These lines thoroughly cover the territory between Chicago, La Crosse, St. Paul, Minneapolis, Aberdeen, Mitchell, Sioux Falls, Sioux City, Yankton, Council Bluffs, Omaha and Northern Michigan. All the principal cities and towns in that territory are reached by the "St. Paul" lines, connecting at St. Paul, Council Bluffs and Omaha with all lines for points in the far west. Write to Geo. H. Heafford, General Passenger and Ticket Agent, Chicago, Ill., for one of their new map time tables and a brochure giving a description of the Compartment Sleeping Cars. Tickets furnished by any coupon ticket agent in the United States and Canada. The finest dining cars in the world are run on the solid vestibuled, electric-lighted and steam-heated trains of the Chicago, Milwaukee & St. Paul Railway.

BALLOON MANUFACTURE.

Balloons of every description. Silk, Gold Beaters' Skin, etc. Military Balloons, Captive Balloons for Exhibitions, Captive Advertising Balloons, etc.

Inventions worked out from plans on large scale or model. Grotesque Figure, Animal and Toy Balloons in Gold Beaters' Skin. Scientific ascents conducted. Price lists on application.

AUGUSTE E. GAUDRON, Aeronaut and Balloon Manufacturer,
7 Victor Road, London, N., England.

PURE AIR IN PASSENGER CARS

Without Dust, Draft or Cinders.

NO ADDITIONAL COST ON NEW CARS.
SMALL COST ON OLD CARS.
PERFECT VENTILATION.

Send for Catalogue.
Palmer Ventilator Co.,
Bowdoin St., BOSTON, MASS.

F. W. DEVOE & CO., (ESTABLISHED 1852.)

Fulton Street, Cor. William, New York.

FURNISHERS OF

Paints, Coach Colors, Fine Varnishes.

ccording to Specifications, to

Pennsylvania Railroad Company,
New York Central & Hudson River R.R.,
New York, Lake Erie & Western Ry.,
Del., Lack. & Western Ry.,
and others.

---

eam Heating from the Locomotive:
Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,199. **SEWALL COUPLERS** sold 55,617; the standard in U. S. and Canada.

Electric Heaters for Street Cars:
1,103 Car Equipments sold from Aug. 1 to Dec. 1. West End Boston, People's Traction Philadelphia, Nassau Ry. Brooklyn, Union Ry. Providence and Buffalo Railway have recently ordered over 700 Car Equipments.

CONSOLIDATED CAR-HEATING CO.

ALBANY

ipe Light Compressed Oil Gas:
Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

Albany, N. Y., 413-423 North Pearl Street:
CHICAGO, 200 WESTERN UNION B'LD'G; Canada, Coaticook, P. Q.—London—Moscow. Specially tested fittings and car lighting repair parts at reasonable prices. Electric Heaters for offices.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.

ESTABLISHED 1824. A SCHOOL OF ENGINEERING. SEND FOR A CATALOGUE.

TRADE VALENTINES MARK.

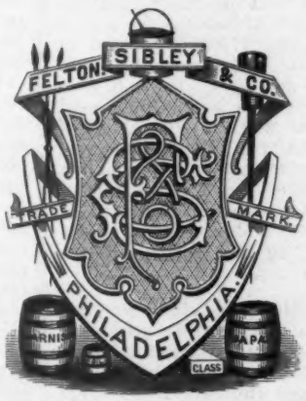
VALENTINE & COMPANY,

MANUFACTURERS OF HIGH GRADE

oach and Railway Varnishes and Colors,

57 BROADWAY, NEW YORK.

o Wabash Ave., CHICAGO. *164 Purchase St., BOSTON.* *21 Rue de Lappe, PARIS.*



SUPERFINE COACH and CAR COLORS in Oil and Gold Size Japan.

HIGH GRADE VARNISHES and UNSURPASSED DRYING JAPANS

Smokestack Black

A SPECIALTY.

FELTON, SIBLEY & CO.,

PHILADELPHIA, PA.

PRESSES, DIES, AND OTHER
SHEET-METAL TOOLS
FERRACUTE MACHINE CO.
BRIDGETON, N. J. U.S.A.

"1889" "LITTLE GIANT"
RUE INJECTOR
Mfg. Co., PHILA. PA.

American Engineer and Railroad Journal
NOW ISSUED BI-WEEKLY
See Prospectus on page XXIII.
Order direct or through your Newsdealer

Price reduced to
10 cents
Yearly Subscription, $2.50

---

00 IN USE
or Naval and
arine Purposes

The ROBERTS SAFETY WATER TUBE BOILER

SEND FOR HANDSOME ILLUSTRATED CATALOGUE 39 CORTLANDT STREET, N. Y.

Political Reform

BY THE

Representation of Minorities.

By M. N. FORNEY.

The Book is published by the author, and will be sent by mail on receipt of the price, which is $2.50.

47 CEDAR ST., N. Y.

The aim of this book is, first, to describe briefly the evils growing out of the present system of electing by a majority of the votes cast in each district, single members to represent the people in it, in national, State, and municipal legislative assemblies; second, to show how some of these evils would be remedied by giving minorities as well as majorities representation in our legislative bodies; third, to describe how this is done in Illinois by the system of cumulative voting, which was adopted in that State more than twenty years ago for the election of members of its House of Representatives; fourth, to describe the results and workings of that system, and show its advantages and disadvantages; fifth, to indicate how the latter may be obviated; sixth, to describe a method of election which, it is thought, would overcome the difficulties inherent in cumulative voting; seventh, to show how the proposed method of election would lessen many of the political evils from which we are now suffering, and to indicate the reforms which would result therefrom; eighth, to compare some of the different systems which have been proposed for securing minority representation and show their merits and defects; and ninth, to give a bibliography of minority or proportional representation for those who are disposed to give the subject more extended study.

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHERS' DEPARTMENT.

General Notes.

The Foster Engineering Company, of Newark, N. J., write us that they are manufacturing a valve that would have prevented the recent disaster in the engine-room of the Olympic Theatre. It is an automatic safety stop valve which has been designed to meet just such emergencies. In the event of the bursting of the pipes or other serious danger to the piping system the valve instantly and automatically shuts off the steam from the boiler, thus preventing its escape with all of the attending consequences. It is applicable to large steam plants, factories, steamships, steam-heated buildings, etc.

American Society of Mechanical Engineers.—At the meeting for the election of officers that was held on the 4th of this month, the following officers were elected for the ensuing year: President, John Fritz, of Bethlehem, Pa.; Vice-Presidents, F. H. Ball, of New York; Jesse M. Smith, of Detroit; M. L. Holman, of St. Louis; George W. Melville, of Washington; Charles H. Manning, of Manchester, N. H., and Francis W. Dean, of Boston; Managers, John B. Herreshoff, of Bristol, R. I.; L. B. Miller, of Elizabeth, N. J.; W. S. Russell, of Detroit; John C. Kafer, of New York; Charles A. Bauer, of Springfield, O.; A. C. Walworth, of Boston; Norman C. Stiles, of Middletown, Conn., and George W. Dickie, of San Francisco; Treasurer, William H. Wiley, of New York.

Engineers' Club at Philadelphia.—At the meeting held on the evening of November 6 the subject of coatings for iron to prevent rusting was discussed. A paper was presented in which it was claimed that though there is no paint known that will adhere so firmly to the surface and be less liable to chip off as good red lead and linseed oil; it is porous, and must be covered by some other paint that will dry with an absolutely impervious and water-proof surface. In the discussion that followed there seemed to be a prevalence of the opinion that red lead was a remarkably efficient means of protecting iron, and the case was cited of a steamboat on the Ohio River that was built during the war and still had its original stacks that had been protected by a coat of red lead applied once a year.

Messrs. Riehle Brothers, of Philadelphia, announce that they will commence the publication of a quarterly pamphlet which will be devoted "to various matters pertaining to physical testing, and which will be arranged under proper headings so as to make the book a ready and valuable one for reference." The prospectus which that company has issued indicates that they are not only enterprising in their own special line of manufacturing testing machines, but that they are now about to enter on the more precarious field of technical journalism. The title of the new publication will be the *Quarterly Digest of Physical Tests and Laboratory Practice*. In this connection we will suggest that if they would devise a testing machine which will determine the limit of elasticity of their and our readers we will order one forthwith—payable in advertising.

Worm Gearing.—A statement that worm gearing, if used for power transmission in electrical works, should be employed only in conjunction with low-speed motors has brought out a statement from E. Kolben, of the Oerlikon Engineering Works, in Germany, who, in a contribution to a German publication, says that high-speed motors should be adopted in such cases if the best results are to be obtained. He points out that a great prejudice against worm gearing has hitherto existed, on account of its having been regarded in the old text and handbooks as an inefficient means of transmission. He believes, moreover, that much depends on the construction of the gearing, and refers to tests recently carried out by Professor Stodola, of the Zurich Polytechnic, with the ordinary double-thread worm gear of the Oerlikon Engineering Works. The worm was 3.15 in. in diameter, had a multiple-ring bearing and engaged with a worm wheel having 28 teeth, the wheel being of bronze 14.7 in. in diameter. The whole gear was placed in oil in a cast-iron box. The gear was coupled to a 20-H.P. electric motor, and the brake was applied on the worm-wheel shaft. At 1,500 revolutions, a useful performance of 21 H.P. was given on the brake, the efficiency amounting to 87 per cent. Mr. Kolben is of the opinion that the efficiency of the motor fully loaded will increase even beyond 90 per cent. if the speed is high, the worm made of tool steel polished, the worm teeth of bronze, and the friction of the whole mechanism on the starting of the motors at full load is reduced by having the pressure taken up by starting disks arranged on both ends of the worm.—*The Engineer*.

Liability for Renewing a Worn-out Part of a Patented Device.—An interesting case was recently decided by Judge Adams, in the Circuit Court of the United States, in St. Louis, when the St. Louis Car Coupler Company was the complainant and the owner of letters patent of the United States for new and useful improvements in car couplings employed the defendant to manufacture about one thousand complete couplers according to the patented device. The defendant proceeded, under such employment, and after finishing the same, continued to manufacture certain important element or part of the patented device called in the patent "the coupling head," and generally referred to in the argument of counsel as "the knuckle," and has since then kept a stock of such knuckles on hand for sale, and has sold and disposed of them without the sanction or authority of the complainant. The defendant claims that it could lawfully manufacture and sell these knuckles to such parties as had purchased the completed device and who needed a knuckle for the purpose of supplying defective or broken ones in such couplers as they had before that time become possessed of.

No question was raised with reference to the validity of the patent. The general principle relied on by defendant's counsel is recognized that if any element of a combination is temporary in its recognition to the whole combination—that is to say, if it is liable to be often worn out, and if the inventor contemplates that it would have to be frequently replaced anew during the time the machine as a whole might last, such circumstances and intention would entitle an owner of the patented device to procure or manufacture such temporary part at his pleasure and thereby incur no liability as an infringer.

The judge held that the facts did not support their contention. It appears that these knuckles turned out to be more liable to breakage than the drawheads, the other main element of the combination, but neither the physical relation of these parts to each other nor the evidence in the case satisfies us that the knuckle was regarded by the inventor as temporary and as necessarily requiring to be frequently replaced, and bearing in mind that the knuckle is the chief element in the patented combination, it seems to me that the use of it to supply the place of knuckles worn out or broken in actual use amounts to reconstruction and not repair.

A decree was ordered finding that defendant infringes and for an injunction at accounting.

Uses for Old Railway Rolling Stock.—A correspondent of the *Railway Herald* recently gave an account of the uses to which old railway materials are put upon the English line with which he is connected. In dealing with carriages, he says that "when they are set aside as unfit for their original purpose, they are by no means useless, and may often be seen, minus their wheels and partitions, in station yards and goods depots, where they serve the purposes of lamp or store-rooms, and shelters for shunters and others. The public also find a use for them, and they are to be met with as pavilions on lawn tennis and cricket grounds. It is greatly to the credit of one of the leading companies that it hit upon the expedient of getting rid of its old stock for such purposes, an example which several other companies might follow with advantage. At some places, such as level crossings in remote places, old carriages are used as dwelling-places for the gate-keepers, and it would appear they are not unknown to the general public for that purpose. Sleepers, when discarded for use on the permanent way, are still useful for fencing purposes, and strong fences they make, not by any means ornamental, but most substantial. They are sometimes used for making the retaining walls of ballast platforms, and also for constructing those odd-looking huts used by plate layers for tool houses and shelters, and so frequently seen along the line. Another of their uses is for firewood, and they make excellent kindling for any one who has the time and muscle requisite for chopping them up.

"Old rails also have their uses. After doing service on the main line, and subsequently on the siding, when unfit for their original use they are still available for many purposes. By dint of much bending they form fairly good buffer stops. Farmers in the vicinity of railways find them useful, as very

o Air Valves or Pumps,
No Leaking or Freezing,
No Pipes, Rusted Chain or Cranks,

Operated from Grade or Tower House,
Guaranteed Absolutely for a Period of Years,
A Practical Summer and Winter Gate.

THE DAYTON RAILWAY CROSSING GATE.

ERECTED ON TRIAL, SUBJECT TO ACCEPTANCE AND APPROVAL.

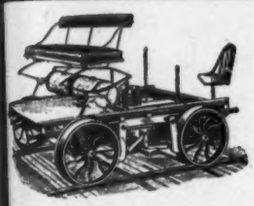
ESTIMATES FURNISHED.

THE CRAIG-REYNOLDS FOUNDRY CO.,

DAYTON, OHIO.

EASTERN AGENT,
NEST S. CRONISE, Room 33, 37 Broad St., New York.

WESTERN AGENT,
JOHN McKINNON, 374 The Rookery Bldg., Chicago, Ill.



Kalamazoo R. R. Velocipede and Car Co.,

KALAMAZOO, MICH., U. S. A.

Gasoline Motor Inspection Car.

It has no fire exposed.
It is free from any possibility of explosion.
It is ready to start at a moment's notice.

PERFECTLY RELIABLE.

MANUFACTURERS OF

STEEL WHEEL HAND CARS, STEEL VELOCIPEDE CARS, STEEL SURFACE CATTLE GUARDS, and a New RAILWAY TRICYCLE, constructed with ball bearings and throughout similar to a road bicycle.

Send for Catalogue and mention this Journal.

—THE—

BETHLEHEM

IRON COMPANY,

SOUTH BETHLEHEM, PENNA.

STEEL + RAILS,

BILLETS AND MUCK BAR,

STEEL FORGINGS.

HOLLOW SHAFTING, CRANKS, ROLLS, GUNS AND ARMOR,

Rough, Machined or Finished, Fluid Compressed, Hydraulic Forged

NEW YORK OFFICE, - 80 BROADWAY.

Philadelphia Office: 421 Chestnut Street.

FISHER & PORTER, 1025 Monadnock Block, Chicago, Western Sales Agents.

JOHN A. WILSON, *Civil Engineer.* JOSEPH M. WILSON, *Civil Engineer and Architect.* HENRY W. WILSON *Civil Engineer.*

WILSON BROTHERS & CO.,

Civil Engineers, Architects and Consulting Engineers.

CHAS. G. DARRACH, *Civil & Hydraulic Eng'r.* DREXEL BUILDING: Cor. Chestnut and Fifth Streets, HENRY A. MACOMB, *Architect.*

PHILADELPHIA, PA.

SOOYSMITH & CO.,

Incorporated,

CONTRACTING ENGINEERS,

MILLS BUILDING, 15 BROAD ST., NEW YORK.

PASCHKE, VAN HORNE & KELLEY,

CIVIL ENGINEERS

Rooms 716, 717 & 718 Havemeyer Building, New York City.

Cable Address: "PaskeL." A. B. C. or Anglo-American Code.

All kinds of Surveys carefully made. Plans and Specifications for Railroads, Water Works, Water Power, Sewerage, and their superintendence Topographical Relief Models made. Examinations and Reports upon all Public Enterprises and Properties in Spanish-American Countries.

Correspondence in English, Spanish, German and French.

LOUIS P. EVANS,

Engineer and Contractor,

Designs furnished if required. Railroad Bridges and Trestle Work. Mill and Factory Buildings, etc.

S. E. Corner 4th and Walnut Sts., Philadelphia, Pa.

NEW YORK CENTRAL & HUDSON RIVER R. R.

The Great Four-Track Trunk Line of America.

Wagner Palace Sleeping and Drawing-Room Cars on all Through Trains.

All through trains arrive at and depart from Grand Central Station, Fourth Ave. and 42d Street, New York, the very centre of the city.

...n M. Toucey, Gen'l Manager.
...o. H. Daniels, Gen'l Passenger Agent.

The Direct Line between New York AND Niagara Falls.

GOOD PATENTS

PROCURED IN ALL COUNTRIES.

GRANT INSURED.

30 YEARS' PRACTICE.

Reliable, prompt service. Fair charges. Advice as to patentability. Pamphlet and References *free*. Write to

CHAS. J. GOOCH, Patent Attorney, WASHINGTON, D. C.

MACHINERY — CUTS — A SPECIALTY.

JAMES S. CONANT & CO.

Engravers on Wood

3 Franklin St., BOSTON.

GEO. L. FOWLER,

Consulting Mechanical Engineer,

53 BROADWAY, NEW YORK.

PENNSYLVANIA RAILROAD.

The Standard Railroad of America.

The Only Four-track Line Leading Out of New York City.

Connecting all the principal cities on the Atlantic Coast with those in the Mississippi Valley and on the Great Lakes. Through trains with Pullman Vestibule, Buffet, Sleeping and Dining Cars attached, between New York, Philadelphia, Washington and Baltimore and Chicago, St. Louis, Cincinnati and Louisville.

S. M. PREVOST, General Manager. J. R. WOOD, General Passenger Agent.

ALFRED A. HUNTING,

Consulting and Mechanical Engineer,

Plans of Steam Plants for Mills and Street Railways a Specialty.

618 John Hancock Building, Boston, Mass.

WM. A. ROSENBAUM,

ELECTRICAL EXPERT AND SOLICITOR OF PATENTS,

Formerly Manager of, now successor to, the Patent Business heretofore conducted by "The Electrical World."

Times Building, New York.

good temporary bridges over ditches and small streams can be made by throwing a few old rails across and placing sleepers transversely over them. On the cliffs, between Folkestone and Dover, and directly above the Channel Tunnel Works, is a sort of skeleton lighthouse composed entirely of old rails most ingeniously bent and bolted together.

"Turning now to locomotives, we find these 'monarchs of the iron road' ending their busy days in a variety of ways. Some, after running for many years, find an honored retirement in a museum or a prominent position in some public place, such, for example, as *Puffing Billy* in the South Kensington Museum, and *Locomotion*, preserved by the Northeastern Railway at Darlington. Others, useful to the very last, meet the reward of long service on the line by ending their days as contractors' engines, or shunting engines at collieries; and at least one instance is on record of a well-known engine being consigned to a pumping station for use as a stationary engine—a case which seems almost parallel with that of the Derby winner ending his days on a cab-rank. The identity of most engines, however, is lost in the scrap heap. In conclusion, it may be stated that uses have been found for nearly all old railway stores, material and rolling stock."

Bids for the New Battleships.—Bids for constructing these battleships were opened at the Navy Department on November 30. Six bids were submitted by three bidders—William Cramp & Sons, of Philadelphia; the Union Iron Works, of San Francisco, and the Newport News Shipbuilding & Dry Dock Company, of Newport News, Va. When the bids were opened there were some surprising features. These were the low bids submitted by the Newport News Company, and the offer of the Cramps to construct the armor, guns and protective features of the battleships—work heretofore and at present entirely done by the Government. But the Cramp Company went even further than this, and not only offered to build the two vessels, with hull and armor, for the sum of $8,000,000—a price estimated to cover the cost of their construction and armament by the Government—but included in this amount another vessel without armament. The offer to build three vessels where appropriations were made only for two is unprecedented in the history of the new Navy.

The Cramp Company submitted three classes of bids, the Union Iron Works two classes and the Newport News one class. The Newport News Company submitted the lowest bid for constructing the vessels on the plans prepared by the Navy Department. In this class the bids submitted were:

Newport News Company.—For constructing one of the vessels, $2,350,000; for constructing both vessels, $2,250,000 each.

The Union Iron Works.—For one vessel, $2,740,000; for both vessels, $2,640,000 each.

Cramp & Sons.—For one vessel, $2,820,000; for both vessels, $2,750,000 each.

On plans prepared by the bidders, Cramp & Sons offered to build one battleship for $2,500,000, or $2,450,000 each for both, and in the same class—plans prepared by themselves—the Union Iron Works offered to build one vessel for $2,650,000, or $2,640,000 each for both. The other bids submitted were by the Cramps, based on plans prepared by themselves and containing the special features mentioned with reference to armament. These bids were: For three battleships, $8,000,000, including hull and armor for two ships; two vessels for $3,850,000 each, including hull, armor and gun protection; one vessel for $2,500,000, or both for $2,450,000 each.

The six different schemes which Cramp & Sons included in their bid embraced two general types of ships, namely, No. 2 and No. 3, regular turret ships, generally similar in construction to the *Indiana* except that one of them—scheme 3—involved a water-line belt extending the whole length of the ship. Schemes 4 and 5 embodied the barbette system, with shield turrets mounting either 12-in. or 13-in. guns, according to the scheme. Scheme 6 involves one 13-in. gun in each turret forward and aft and eight 10-in. guns in pairs in four barbettes with shield turrets instead of the eight 8-in. guns, as provided in the other schemes. Scheme 7 incorporates the Cramps' hull and machinery and the double-turret feature of the Department's plan.

MAP OF THE UNITED STATES.

A LARGE, handsome map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of 15 cents in postage by P. S. Eustis, General Passenger Agent, Chicago, Burlington & Quincy Railroad, Chicago, Ill.

THE PENNSYLVANIA RAILROAD

is favored with the patronage of the best class of travelers.

Why?

Because, with complete protection by the block-signal, automatic and interlocking switches, and an unsurpassed roadbed, it is the safest.

Because, with a superb service of perfectly appointed trains, it is the most comfortable.

Because, with wise management and unlimited facilities, it is the promptest.

These reasons are heavy, and they tip the balance on the side of the "standard railway of America."

LOW EXCURSION RATES SOUTH AND PACIFIC COAST.

THE Southern Railway (Piedmont Air Line) have just issued a circular announcing low excursion rates to Southern cities and winter resorts. The new points to which excursion tickets are sold this winter includes many prominent Southern cities. This great system penetrates every Southern State over its own rails; operates solid trains, vestibuled sleeping and dining cars, from New York to New Orleans, Jacksonville, Tampa, Atlanta, Augusta, Asheville, Chattanooga, Birmingham, Memphis. This is the route that forms the great California Limited *via* New Orleans in connection with the Sunset Limited, the most elegantly appointed train service between the Atlantic and Pacific. For rates, schedules, etc., call on or address R. D. Carpenter, General Agent; Alexander S. Thweatt, Eastern Passenger Agent, 271 Broadway, New York.

"BODY RESTED, MIND AT EASE."

That is what it is when travelling on the fast trains of the Chicago, Milwaukee & St. Paul Railway; besides there is no chance to "kick," for the accommodations are up to date, the trains keep moving right along and get there on time. These lines thoroughly cover the territory between Chicago, La Crosse, St. Paul, Minneapolis, Aberdeen, Mitchell, Sioux Falls, Sioux City, Yankton, Council Bluffs, Omaha and Northern Michigan. All the principal cities and towns in that territory are reached by the "St. Paul" lines, connecting at St. Paul, Council Bluffs and Omaha with all lines for points in the far west. Write to Geo. H. Heafford, General Passenger and Ticket Agent, Chicago, Ill., for one of their new map time tables and a brochure giving a description of the Compartment Sleeping Cars. Tickets furnished by any coupon ticket agent in the United States and Canada. The finest dining cars in the world are run on the solid vestibuled, electric-lighted and steam-heated trains of the Chicago, Milwaukee & St. Paul Railway.

BALLOON MANUFACTURE.

Balloons of every description. Silk, Gold Beaters' Skin, etc. Military Balloons, Captive Balloons for Exhibitions, Captive Advertising Balloons, etc.

Inventions worked out from plans on large scale or model. Grotesque Figure, Animal and Toy Balloons in Gold Beaters' Skin. Scientific ascents conducted. Price lists on application.

AUGUSTE E. GAUDRON, Aeronaut and Balloon Manufacturer,
7 Victor Road, London, N., England.

PURE AIR IN PASSENGER CARS

Without Dust, Draft or Cinders.

NO ADDITIONAL COST ON NEW CARS.
SMALL COST ON OLD CARS.
PERFECT VENTILATION.

Send for Catalogue.

Palmer Ventilator Co.,
Bowdoin St., BOSTON, MAS

GIFT
DEAN M. E. COOLEY

(Established 1832.)

AMERICAN ENGINEER AND RAILROAD JOURNAL.

Annual Subscription $2.50.
Foreign Postage, $1.00 extra.

Published Bi-weekly at 47 Cedar Street, New York, by
M. N. FORNEY.

Single Copies, 10c.

Vol. LXIX, No. 14.
Sixty-fourth Year.

DECEMBER 12, 1895.

Entered at the Post Office as Second-Class Mail Matter.

CONTENTS.

Editorial Notes..... 577
Railroad Racing..... 577
The Most Advantageous Dimensions for Locomotive Exhaust Pipes and Smokestacks (Illustrated)..... 559
Some Difficulties of Electric Railroading..... 563
The Occupation of an Engineer..... 565
New Express Passenger Locomotive for the Chicago, Burlington & Quincy Railroad (Illustrated)..... 569
Shop Notes..... 570
The Atlanta Exposition (Illustrated)..... 572
The Storage Battery for Central Stations..... 574
The Storage Battery or the Gas Engine as an Auxilliary.. 576
Pony Truck by H. K. Porter & Co. (Illustrated)..... 577
A Captive Balloon at the Champs de Mars (Illustrated).. 578
Description of a Locomotive Depot for the Accommodation of 180 Engines and Tenders..... 578
Ingersoll Drills on the Chicago Drainage Canal..... 580
Death of Mr. Patrick Stirling..... 580

Screws, Taps, Dies, &c.

THE CINCINNATI SCREW & TAP CO., Cincinnati, O., U. S. A.

SHEFFIELD STANDARD CATTLE GUARD.

The Best Device for Turning Stock Yet Brought Out.

SHEFFIELD CAR CO., Sole Mfrs., Three Rivers, Mich.

TURNBUCKLES.

Branch Office:
136 Liberty St.,
NEW YORK.

Made by
Cleveland City Forge & Iron Co.,
CLEVELAND, OHIO.

DROP FORGED

MERRILL BROS., 465-471 Kent Ave., Brooklyn, E. D., N. Y.

DROP FORGED OF STEEL.

Armstrong Boring Tool,

A Practical All-Around Boring and Threading Tool.

One Tool will take the place of nearly a dozen forged tools.

SEND FOR CIRCULARS TO

PATENT APPLIED FOR.

ARMSTRONG BROS. TOOL CO.,
76-78 EDGEWOOD AVE., CHICAGO, ILL.

American Engineer and Railroad Journal
NOW ISSUED BI-WEEKLY
Formerly Monthly
PRICE 10 CENTS
Formerly 25 cents
ANNUAL SUBSCRIPTION $2.50
Formerly $3.00
(Foreign Postage $1.00 Extra)

For Punching IRON AND STEEL.

"CYRUS ROBERTS"

Hand • Car • Specialties.

INSULATED [STEEL WHEEL.

Warranted

EASY RUNNING, LIGHT IN WEIGHT,
PERFECT WHEEL.

ROBERTS, THROP & CO., Three Rivers, Mich.

Ramapo Wheel & Foundry Co., Ramapo, N.Y.

MANUFACTURE

SECTION OF BOLTLESS FASTENING.

SNOW'S BOLTLESS STEEL-TIRED WHEELS for PASSENGER CARS LOCOMOTIVES

Tires having Annular Web and Hook. Wedge-shaped Retaining Ring, Best Charcoal Iron Double Plate or Spoke Centers. Simple. Safe. Economical. Continuous Circumferential Fastening.

CHILLED IRON WHEELS of Superior Quality for Cars and Locomotives.

CONGDON BRAKE SHOES, Which outwear from 4 to 6 ordinary Cast Iron Shoes.

CYLINDER PACKING RINGS from SPECIAL METAL. Uniform in Wear. Resilient. Satisfaction assured.

RAMAPO IRON WORKS

HILLBURN, NEW YORK.

MANUFACTURE

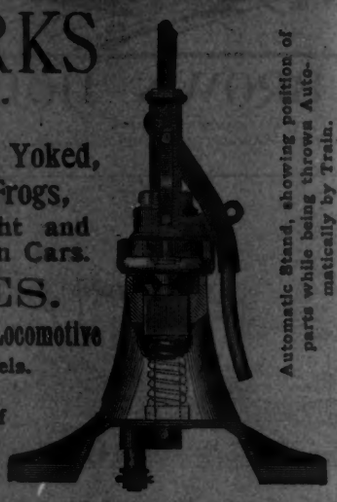
Automatic Stand, showing position of parts while being thrown by hand.

Automatic Safety Switch Stands, Yoked, Bolted, Plate and Spring-Rail Frogs, Switches, Crossings, Track Equipment, Light and Heavy Castings, Narrow Guage and Plantation Cars.

BRAKE SHOES.

ROSS, for Steel-Tired Car and Truck Wheels.
SHEPPARD, for Bald or Blind Tired Wheels.

ROSS-MEEHAN, for Locomotive Driving Wheels. Prevent Flange wear. Save Cost of Turning.


Automatic Stand, showing position of parts while being thrown Automatically by Train.

ADOPTED BY LEADING RAILROADS.

. . THE . .

Curtis Water Pressure Regulator

Is guaranteed to deliver street or pump pressure into pipes at any desired pressure, and however the outside pressure may fluctuate, will deliver uniformly and permanently at the point at which it is set. It obviates wear and tear by water-hammer or concussion in pipes, and reduces intermittent hydraulic pressure to any desired pressure.

MADE BY THE

D'ESTE & SEELEY CO.,

29-33 Haverhill St., Boston, Mass.

New York: 109 Liberty St. Chicago: 218 Lake St.

Perforated Metals

OF EVERY DESCRIPTION FOR ALL DEPARTMENTS OF

Railway Work.

FOR USE IN

Spark Arresters, Extension Fronts, Cones, Deflector Plates, etc.

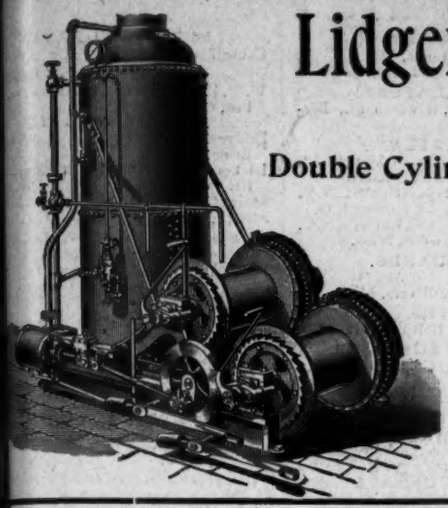
Perforated Brass, Bronze and Copper for Deck Sash Lights, Ventilators, Screens, etc.

PERFORATED TIN AND BRASS OF ALL SIZES.

THE HARRINGTON & KING PERFORATING CO.,

Nos. 224-240 North Union St., CHICAGO.

Eastern Office—284 Pearl St., New York.



Lidgerwood Manufacturing Co.,

96 LIBERTY STREET, NEW YORK CITY, N. Y.

Double Cylinder, Improved Patent Friction Drum, Portable

HOISTING ENGINE,

with Boiler and Fixtures complete on bed plate.

SPECIALLY ADAPTED for **RAILROADS,** CONTRACTORS, DOCKS and QUARRIES.

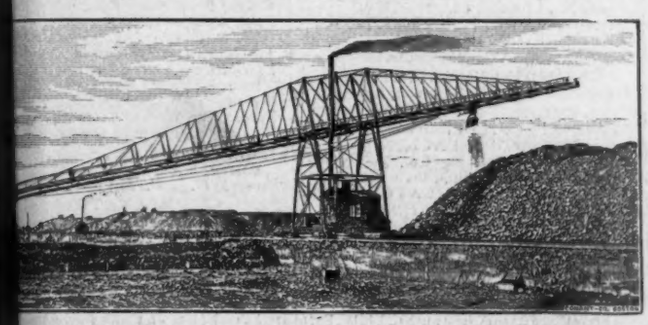
ALSO MANUFACTURERS OF "THE RAPID UNLOADER," A NEW DEVICE FOR UNLOADING FLAT CARS (PATENTED SEPT. 20, 1892). WRITE FOR PARTICULARS.

HE BROWN HOISTING & CONVEYING MACHINE CO.,

ew York Office, HAVEMEYER BUILDING. Western Office, MARQUETTE BUILDING, Chicago, Ill.

CLEVELAND, OHIO, U. S. A.

Pittsburgh Office, 1112 CARNEGIE BUILDING.



Complete Systems for Handling of Materials.

THE BROWN PATENT

Bridge Tramway, Cable Tramway, Shed Tramway, Warehouse Tramway, Sewer Machine Tramway, Automatic Furnace Hoist

The most perfect machinery for handling ORE, COAL, etc., from vessels, docks and cars.

SOLE MAKERS OF

The Brown Patent Cantilever Cranes, in Use on the Chicago Main Drainage Canal.

Working Capacity of "CANTILEVER" 550 to 700 yards "solid rock n place" per day of 10 hours.

The best machinery for handling material in Ship Building Yards such as MARINE PLATES, ARMOR PLATES, STRUCTURAL WORK, Etc.

Designers and Builders of Traveling, Locomotive, Jib, Pillar, ther Cranes, Friction Clutch Hoisting Engines, Boilers, Skip Cars, Self-Dumping Buckets, Friction Clutches, etc.

WIRE ROPE
FOR ALL PURPOSES
IRON AND STEEL WIRE OF ALL KINDS WIRE ROPE TRAMWAYS
TRENTON IRON CO.
N.Y. OFFICE
COOPER, HEWITT & CO.
17 BURLING SLIP
TRENTON, N. J.
CHICAGO OFFICE 1114 MONADNOCK BUILDING

CUT THIS OUT!

Railway Department,
ONAL MALLEABLE CASTINGS CO.,
25 Old Colony Bldg., Chicago, Ill.

Please mail to my address a copy of your illustrated pamphlet on the TOWER COUPLER.

_____

_____

_____

posted regarding progress in M. C. B. Coup-ers, by watching the Tower, which leads the procession.

INDEX TO ADVERTISEMENTS.

AIR BRAKES.
Westinghouse Air Brake Co., Pittsburg, Pa.
American Brake Co., Pittsburg, Pa.

AIR COMPRESSORS.
Clayton Air Compressor Works, 26 Cortlandt St., New York.
Norwalk Iron Works Co., So. Norwalk, Conn.

ARMOR PLATE AND GUNS.
Bethlehem Iron Co., So. Bethlehem, Pa.

ASPHALT PAINT.
Warren Chemical and Mfg. Co., 81 Fulton St., New York.

AUTOMATIC BOILER FEEDS.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.

AXLE-BOX LUBRICATOR.
J. T. Connelly, Milton, Pa.

BALLOONS.
Gaudron, August C., 7 Victor Road, London, N., England.

BELTING.
Boston Belting Co., 256 Devonshire St., Boston, Mass.

BOILER & PIPE COVERING.
Am. Heat Insulating Co., Pittsburg, Pa.
H. F. Watson Co., Erie, Pa.

BOILERS AND ENGINES.
Abendroth & Root Mfg. Co., 28 Cliff St., N.Y.
Adams Boiler Co., Cleveland, O.
Almy Water-Tube Boiler Co., Providence, R. I.
Babcock & Wilcox Co., 29 Cortlandt St., N.Y.
Finlayson Water-Tube Boiler Co., P. O. Box 128, Detroit, Mich.
Mosher, C. D., 1 Broadway, New York.
Moyes, L. M., 411 Walnut St., Phila., Pa.
Robert Poole & Son Co., Baltimore, Md.
Roberts Water-Tube Boiler, 39 Cortlandt St., New York.
Shaw, Willis, 416 New York Life Building, Chicago, Ill.
Tippett & Wood, Phillipsburg, N. J.

BOILER FRONTS & FITTINGS.
Vulcan Iron Works, Toledo, O.

BOLT CUTTERS & HEADERS.
Acme Machinery Co., Cleveland, O.
Howard Iron Works, Buffalo, N. Y.

BOOKS.
Forney, M. N., 47 Cedar St., New York.
D. Van Nostrand Co., 23 Murray St., N. Y.
Richards, John.

BRAKE ADJUSTERS.
Pratt & Letchworth, Buffalo, N. Y.
Q. & C. Co., Chicago, Ill.

BRAKE SHOES.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.

BRIDGES.
Youngstown Bridge Co., Youngstown, O.

BRONZE AND BRASS.
Brady Metal Co., 115 Broadway, N. Y.
Crown Smelting Co., Chester, Pa.
Damascus Bronze Co., Pittsburgh, Pa.

CABLE RAILROAD PLANT.
Crook, W. A. & Bros. Co., 143 Liberty St., New York.
Robert Poole & Son Co., Baltimore, Md.

CALKING TOOLS.
Chicago Pneumatic Tool Co., Monadnock Building, Chicago, Ill.

CARS.
Allison Mfg. Co., Philadelphia, Pa.
Carlisle Mfg. Co., Carlisle, Pa.
Harlan & Hollingsworth Co., Wilmington, Pa.
St. Charles Car Co., St. Charles, Mo.
Wason Mfg. Co., Brightwood, Mass.
Youngstown Car Mfg. Co., Youngstown, O.

CAR AXLES.
Cambria Iron Co., 218 So. 4th St., Philadelphia, Pa.
Gould Coupler Co., 66 Broadway, New York.

CAR COLORS & VARNISHES.
Felton, Sibley & Co., Philadelphia, Pa.
Warren Chemical and Mfg. Co., 81 Fulton St., New York.
Valentine & Co., 57 Broadway New York.
John Lucas & Co., Philadelphia, Pa.
F. W. Devoe & Co., Cor. Fulton and William Sts., New York.

CAR COUPLERS.
Gibbons, Charles D., 202 Society of Savings, Cleveland, O.
Gould Coupler Co., 66 Broadway, N. Y.
Johnston Coupler Co., 204 Walnut Place, Philadelphia, Pa.
McConway & Torley Co., 48th St. & A. V. R'y, Pittsburg, Pa.
National Malleable Castings Co., 1525 Old Colony Building, Chicago, Ill.
Pratt & Letchworth, Buffalo, N. Y.
Standard Coupler Co., 26 Cortlandt St., N.Y.

CAR HEATING.
W. C. Baker, 143 Liberty St., New York.
Consolidated Car Heating Co., 413 No. Pearl St., Albany, N. Y.
Safety Car Heating & Light Co., 160 Broadway, New York

CAR LIGHTING.
Consolidated Car Heating Co. Pope Light, 413 No. Pearl St., Albany, N. Y.
Safety Car Heating & Light Co., 160 Broadway, New York.

CAR LUBRICANTS.
Dreher Mfg. Co., 249 Front St., New York.
Signal Oil Works, Franklin, Pa.

CAR PLUSHES.
L. C. Chase & Co., 338 Broadway New York.

CAR ROOFING.
Hutchins, C. B. & Son, Detroit, Mich.

CAR SEATS.
Forney Car Seats, St. Louis, Mo.
Scarritt Furniture Co., St. Louis, Mo.

CAR VENTILATORS!
Palmer Ventilator Co., Bowdoin St., Boston, Mass.

CAR WHEELS.
Allen Paper Car Wheel Co., Chicago, Ill.
Chester Steel Castings Co., Chester, Pa.
Krupp, Thos. Prosser & Son, 15 Gold St., N.Y.
Mowry Car Wheel Works, Cincinnati, O.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Wason, Mfg. Co., Brightwood, Mass.

CATTLE GUARDS.
Bush Cattle Guard Co.
Sheffield Car Co., Three Rivers, Mich.

CLUTCHES.
Robt. Poole & Son Co., Baltimore, Md.

CONTRACTORS' SUPPLIES.
Contractors' Plant Mfg. Co., 129 Erie St., Buffalo, N. Y.
Vulcan Iron Works, Toledo, O.

CONVEYORS.
Brown Hoisting & Conveying Machine Co., Cleveland, O.
Hunt, C. W. Co., 45 Broadway, N. Y.

CORRUGATED FURNACES.
Continental Iron Works, West & Calyer Sts., Brooklyn, N. Y.

CORRUGATED ROOFING.
Shaw, Willis, 416 New York Life Building, Chicago, Ill.

CRANES.
Whiting Foundry Equipment Co., 225 Dearborn St., Chicago, Ill.
Wm. Sellers & Co., Philadelphia, Pa.

CROSSING GATES.
Craig-Reynolds Co., Dayton, O.

CYLINDER LUBRICATORS.
Detroit Lubricator Co., Detroit, Mich.

CYLINDER OIL CUPS.
Nathan M'f'g Co., 92 Liberty St., N. Y.

CYLINDER PACKING.
U. S. Metallic Packing Co., 435 North Broad St., Philadelphia, Pa.

DAMPER REGULATORS.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.

DRAWING INSTRUMENTS.
E. L. Dean, Holyoke, Mass.
Keuffel & Esser Co., 127 Fulton St., N. Y.
Theo. Alteneder & Sons., Philadelphia, Pa.
Queen & Co., Philadelphia, Pa.
Weber & Co., F., 1125 Chestnut St., Phila., Pa.

DREDGING AND DITCHING MACHINERY.
Rob't Poole & Son Co., Baltimore, Md.
Vulcan Iron Works, Toledo, O.

DUMP CARS.
Allison Mfg. Co., Philadelphia, Pa.

ELECTRIC HEATING.
Consolidated Car Heating Co., Albany,

ELECTRIC MOTORS.
W. P. Harrison & Co., Clerk No. 15, Co
bus, O.

EMERY WHEELS.
Bridgeport Safety Emery Wheel Bridgeport, Conn.
Dickerman Emery Wheel & Machine Bridgeport, Conn.
Springfield Mfg. Co., Bridgeport, Conn
Sterling Emery Wheel Mfg. Co., Tiffin

ENGINEERS & CONTRACTORS.
O. Chanute, 5 Ritchie Place, Chicago,
G. L. Fowler, 53 Broadway, N. Y.
Alfred A. Hunting, John Hancock B
ing, Boston, Mass.
Paschke, Van Horne & Kelley, Haven
Building, N. Y.
Tippett & Wood, Phillipsburg, N. J.
Wilson Bros. & Co., Chestnut & Fifth
Philadelphia, Pa.
Rob't Poole & Son Co., Baltimore, Md.
Rosenbaum, Wm. A., Times Building,
Sooysmith & Co., 15 Broad St., N. Y.
Louis P. Evans, 4th and Walnut Sts.,
adelphia, Pa.

ENGINES AND MACHINERY.
Bell Steam Engine Co., Buffalo, N. Y.
Carlisle Mfg. Co., Carlisle, Pa.
Edward P. Allis & Co., Milwaukee, W
Forbes, W. D. & Co., 1303 Hudson
Hoboken, N. J.
Harrisburg Foundry & Machine Wo
Harrisburg, Pa.
Robert Poole & Son Co., Baltimore, M
Frick Company, Waynesboro, Pa.
H. J. McKeown, 106 E. Front St., Cin.
J. S. Mundy, 56 Prospect St., Newark, N
Newburg Ice Machine & Engine Co., N
burg, N. Y.
Westinghouse Machine Co., Pittsburg,
Vulcan Iron Works, Toledo, O.

ENGRAVERS.
Jas. S. Conant & Co., 3 Franklin Str
Boston, Mass.
Stevens, H. L. C., 20 College Place, N.

EXCAVATORS.
Vulcan Iron Works, Toledo, O.

EYE-TESTING APPARATUS.
Queen & Co., Philadelphia, Pa.

FENCES.
De Kalb Fence Co., 1 High St., De Kalb,
Ellwood, I. L. M'f'g Co., De Kalb, Ill.
Page Woven Wire Fence Co., Adrian, M

FIRE EXTINGUISHERS.
Nathan M'f'g Co., 92 Liberty St., N. Y.

FIRE KINDLERS.
J. S. Leslie, Paterson, N. J.

FLEXIBLE SHAFTING.
Stow Manufacturing Co., Binghamton, N.

WARREN'S

ANCHOR BRAND

Registered

Trade Mark.

NATURAL ASPHALT

Roofing and Paving Materials

AND

INSULATING BITUMEN.

MANUFACTURED ONLY BY

WARREN CHEMICAL & M'F'G CO.,

81 and 83 Fulton Street, New York, U. S. A.

EUREKA NUT LOCK.

STRONGEST SPRING WASHER MADE.

ABSOLUTELY HOLDS NUT AND BOLT SECURE.

Never known to fail in use on Track-joints, Bridges, Engines, Cars, Vehicles, etc.

All sizes made, both for iron and wood work. More reliable than double nuts or cotter pins.

— ALSO —

Full Line Standard Track Tools.

EUREKA NUT LOCK CO.,
Pittsburgh, Pa.

The Thurman Fuel Oil Burner Co.,

DESIGNERS, CONTRACTORS, AND ENGINEERS FOR COMPLETE FUEL OIL EQUIPMENTS.

GENERAL OFFICES: 31 & 32 Cordova Building, INDIANAPOLIS, IND.

For Boilers, Furnaces, Ovens, Forges, Dryers, Etc.

Acknowledged the best. Absolutely Smokeless.

Hot Air from Furnace.
BURNER NO 6.

Hot Air from Furnace.
BURNER NO. 4.

BRANCHES—1401 Monadnock Block, Chicago, Ills.
121 & 23 Fremont St., San Francisco, Cal.

NOTE.—If you are using oil as fuel and are not getting good results, we would be pleased to send you our burners on trial. The oil in our burners can be atomized by either steam or air.

Write for Catalogue.

JUST PUBLISHED.

Thirteen Plates, with Descriptive Text. Oblong, Boards,

LETTERING OF WORKING DRAWINGS

BY

J. C. L. FISH, C.E.,

Assistant Professor of Civil Engineering in the Leland Stanford Junior University.

"This is believed to be the first presentation of a collection styles of lettering made up directly from working drawings.
"Brief remarks on the details of the construction of the sim plest style of alphabet, on lettering in general, and on the make up of titles, precede the general collection."—*Author's Preface.*

D. VAN NOSTRAND COMPANY,
PUBLISHERS,
23 Murray and 27 Warren Sts., NEW YORK

**** Copies sent by mail, postpaid, on receipt of price.*

INDEX TO ADVERTISEMENTS.

FORGINGS.
Coupler Co., 66 Broadway, N. Y.
FOUNDRIES.
Poole & Son Co., Baltimore, Md.
FOUNDRY EQUIPMENT.
Foundry Equipment Co., 225 Dear- St., Chicago, Ill.
FOUNDRY TOOLS.
Bros. Test. Mach. Co., 9th St., Master, Philadelphia, Pa.
FROGS.
Mfg. Co., Carlisle, Pa.
Steel Co., 208 So. 4th St., Phila., Pa.
Iron Works, Hillburn, N. Y.
Frog & Switch Co., Cincinnati, O.
GAUGES AND TOOLS.
Whitney Co., Hartford, Conn.
GEARING AND SHAFTING.
Poole & Son Co., Baltimore, Md.
Steel Castings Co., Chester, Pa.
GRAPHITE.
Dixon Crucible Co., Jersey City, N. J.
GRINDING AND POLISHING MACHINERY.
Emery Wheel & Machine Co., Bridgeport, Conn.
HAND CARS.
Railroad Velocipede Car Co., Kalamazoo, Mich.
Throp & Co., Three Rivers, Mich.
Car Co., Three Rivers, Mich.
Car Co., St. Charles, Mo.
Mfg. Co., Brightwood, Mass.
HOISTING MACHINERY.
Hoisting & Conveying Machine Co., Cleveland, O.
Mach. Co., The John F.; Ravenna, O.
Plant Mfg. Co., 129 Erie St., Buffalo, N. Y.
W. A. & Bros. Co., 143 Liberty St., N. Y.
C. W. Co., 45 Broadway, N. Y.
McKeown, 196 E. Front St. Cincinnati, O.
Mfg. Co., 96 Liberty St., N. Y.
J. S., Newark, N. J.
Willis, 416 New York Life Building, Chicago, Ill.
W. Mason & Co., Providence, R. I.
Iron Works, Toledo, O.

HYDRAULIC MACHINERY.
Dudgeon, R., 24 Columbia St., New York
Watson & Stillman, 210 E. 43rd St., N. Y.
Riehle Bros. Testing Mach. Co., 9th St., above Master, Philadelphia, Pa.
Wm. Sellers & Co., Philadelphia, Pa.
ICE MACHINERY.
Newburg Ice Machine & Engine Co., Newburg, N. Y.
INJECTORS.
Nathan Mfg. Co., 92 Liberty St., N.Y.
Rue Mfg. Co., Philadelphia, Pa.
Wm. Sellers & Co., Philadelphia, Pa.
IRON BUILDINGS & ROOFS.
Tippett & Wood, Phillipsburg, N. J.
IRON CASTINGS.
Vulcan Iron Works, Toledo, O.
IRON AND STEEL.
B. M. Jones & Co., 13 Oliver St., Boston, Mass.
JACKS.
McSherry Mfg. Co., Middleton, O.
Norton, A. O., 336 Congress St., Boston, Mass.
Riehlé Bros. Test. Mach. Co., 9th St., above Master, Philadelphia, Pa.
Watson & Stillman, 210 E. 43rd St., N. Y.
JOURNAL BEARINGS.
Brady Metal Co., 100 Broadway, N. Y.
Chester Steel Castings Co., Chester, Pa.
Crown Smelting Co., Chester, Pa.
Damascus Bronze Co., Pittsburg, Pa.
JOURNAL LUBRICATORS.
J. T. Connelly, Milton, Pa.
LOCOMOTIVES.
Baldwin Locomotive Wks., Philadelphia, Pa.
Brooks Locomotive Works, Dunkirk, N.Y.
Pittsburgh Locomotive Wks., Pittsburgh, Pa.
Richmond Loco. & Mch. Wks, Richmond, Va.
Rogers Loco. Co., Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N.Y.
LOCOMOTIVE FORGINGS.
Gould Coupler Co., 66 Broadway, N. Y.
LUBRICANTS.
Dreher Mfg. Co., 249 Front St., N. Y.
Signal Oil Works, Franklin, Pa.

MACHINE SCREWS.
Cincinnati Screw & Tap Co., Cincinnati, O.
Hubbell, Harvey, Bridgeport, Conn.
Worcester Mch. Screw Co., Worcester, Mass.
MACHINE TOOLS.
Acme M'f'g Co., Cleveland, O.
Ayer, Henry C., Trenton Ave. & Adams St., Philadelphia, Pa.
Bement, Miles & Co., Philadelphia, Pa.
Bullard Machine Tool Co., Bridgeport, Conn.
Diamond Machine Co., Providence, R. I.
Dunkirk Engineering Co., Dunkirk, N. Y.
Gould & Eberhardt, Newark, N. J.
Wm. Sellers & Co., Incor., Philadelphia, Pa.
The Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., 115 Liberty St., N. Y.
Long & Allstatter Co., Hamilton, O.
Riehle Bros. Testing Mach. Co., 9th St., above Master, Philadelphia, Pa.
Rob't Poole & Son Co., Baltimore, Md.
MALL. IRON CASTINGS.
National Malleable Castings Co., 1525 Old Colony B'ld'g, Chicago, Ill.
NUT LOCKS.
Eureka Nut Lock Co., Pittsburg, Pa.
OILS.
Dreher Mfg. Co., 249 Front St., N. Y.
Signal Oil Works, Limited, Franklin, Pa.
OIL BURNERS.
Thurman Fuel Oil Burner Co., Indianapolis, Ind.
PAINTS AND VARNISHES.
Detroit Graphite M'f'g Co., Detroit, Mich.
Jos. Dixon Crucible Co., Jersey City, N. J.
F. W. Devoe & Co., Cor. Fulton and William Sts., N. Y.
Felton, Sibley & Co., Philadelphia, Pa.
Valentine & Co., 57 Broadway, N. Y.
Harlan's English Varnishes, 4 Gold St., N.Y.
PASSENGER CARS.
Harlan & Hollingsworth, Wilmington, Del.
St. Charles Car Co., St. Charles, Mo.
Wason Mfg. Co., Brightwood, Mass.
PATENTS.
Chas. J. Gooch, Washington, D. C.
PERFORATED METAL.
Harrington & King, Chicago, Ill.
Robert Aitchison Co., Chicago, Ill.

PERIODICALS.
American Engineer, 47 Cedar St., N. Y.
Transport, 35 Parliament St., London.
PIPE TOOLS.
Armstrong Mfg. Co., Bridgeport, Conn.
Wright Wrench Co., Worcester, Mass.
PNEUMATIC CHISELS.
Chicago Pneumatic Tool Co., Monadnock Building, Chicago, Ill.
PORTABLE DRILLS.
Stow Mfg. Co., Binghampton, N. Y.
James G. Timolat, 89 So Fifth Ave., N. Y.
POWER TRANSMISSION.
Robert Poole & Son Co., Baltimore, Md.
Wm. Sellers & Co., Philadelphia, Pa.
PRESSED STEEL.
Fox Solid Pressed Steel Co., Western Union Building Chicago.
PRESSURE REGULATORS.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.
PRESSES AND DIES.
Ferracute Machine Co., Bridgeton, N. J.
PUMPS.
Davidson, M. T. 43 Keap St., Brooklyn, N.Y.
Dean Bros. Steam Pump Co., Indianapolis, Ind.
Geo. F. Blake M'f'g Co., 95 Liberty St., N.Y
Shaw, Willis, 416 New York Life Building Chicago, Ill.
PUNCHES AND SHEARS.
Cady Manufacturing Co., Cleveland, O.
Bliss, E. W. Co., 18 Pearl St., Brooklyn, N.Y.
Dunkirk Engineering Co., Dunkirk, N. Y.
Long & Allstatter Co., Hamilton, O.
Watson & Stillman, 210 E. 43rd St., N .Y.
I. P. Richards, Providence, R. I.
RAILROADS.
Chicago, Burlington & Quincy, Chicago, Ill.
Chic., Columbus, Cincinnati & St. Louis, Cincinnati, O.
Chicago, Milwaukee & St. Paul, Chicago, Ill.
Cincinnati, Hamilton & Dayton.
Fitchburg Railroad, Boston, Mass.
Lake Shore Route, Cleveland, O.
New York Central & Hudson River, N. Y.
Pennsylvania Railroad, Philadelphia, Pa.
Southern, 229 Broadway, New York.

RINDING and OLISHING MACHINERY

List Comprises—

Universal grinders, surface grinders, knife grinders, tool grinders, and a large line of ordinary grinders, also polishing and buffing lathes for bench use and on columns, belt strapping machines, and surface polishers. We make a large line of wood polishing wheels.

AMOND MACHINE CO.,
Providence, R. I. & Chicago, Ill.

FOLSOM'S
Patent Roof Snow Guard

For Roofs of Railroad Stations.

Folsom Snow Guard Co.,
33 Lincoln Street, Boston, Mass.

F. WEBER & CO.,
Engineers' and Draughtsmen's Supplies

Sole Agents for Riefler's Celebrated Round System Drawing Instruments, and Ott's Pantographs and Planimeters.

Drawing and Tracing Papers, Blue Print Papers and Linen, Etc.

1125 CHESTNUT ST., PHILADELPHIA.
Branch Houses: St. Louis, Mo.; Baltimore, Md.

OUR JACK SCREWS AND VISES Awarded Medal and Diploma at World's Fair, Chicago.

FIG. 1.—MACHINIST.

They have Qualities that are Undisputed.

FIG. 2.—COACHMAKER'S.

(*Patented December* 27, 1892.)

One movement in and out, one turn of the hand, and the work is secured.

THE CAPITAL MACHINE TOOL CO., Auburn, N. Y.

Radius Link Planer Attachment

This attachment is used in planing curves of any radius, and perfectly parallel curves, as applied to the ordinary planing machine. Quickly attached; easily operated; does accurate work.

For Circulars and Prices, address HENRY C. AYER

TRENTON AVENUE MACHINE WORKS,
Philadelphia, Pa.

OFFICE & WORKS:
E. Cor. Trenton Ave. & Adams St.

INDEX TO ADVERTISEMENTS.

RAILROAD CASTINGS.
Dutcher Co., J. A. & P. E., Milwaukee, Wis.
Vulcan Iron Works, Toledo, O.

RAILROAD SUPPLIES.
Chester Steel Castings Co., Chester, Pa.
Q. & C. Co.

R. R. AND SPECIAL TRUCKS.
Whiting Foundry & Equipment Co., 235 Dearborn St., Chicago, Ill.
Riehle Bros. Testing Mach. Co., 9th St., above Master, Philadelphia, Pa.

REFRIGERATING MACHINERY.
Frick Company, Waynesboro, Pa.

RENOVATORS (PLUSH).
Restauro Mfg. Co., 39 Cortlandt St., N. Y.

ROD PACKING.
H. J. Delaney & Co., Milwaukee, Wis.
U. S. Metallic Packing Co., 435 No. Broad St., Philadelphia, Pa.

ROLLING-MILL MACHINERY.
Rob't Poole & Son Co., Baltimore, Md.

ROOFING.
Hutchins, C. B. & Son, Detroit, Mich.
Warren Chemical & Mfg. Co., 81 Fulton St., New York.

RUBBER GOODS.
Boston Belting Co., 256 Devonshire St., Boston, Mass.

RUST-PROOF IRON.
G. W. Gesner, 15 State St., New York.

SAFETY VALVES.
Ashton Valve Co., Boston, Mass.
CrosbySteamGage&ValveCo., Boston, Mass.

SANDING APPARATUS.
Henry L. Leach, 70 Kilby St., Boston, Mass.

SCHOOL FOR MECHANICS.
Correspondence School of Industrial Science, Scranton, Pa.

SCREW MACHINERY.
Hubbell, Harvey, Bridgeport, Conn.

SEPARATORS.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.

SHAFTING, PULLEYS, ETC.
Robert Poole & Son Co., Baltimore, Md.
Wm. Sellers & Co., Philadelphia, Pa.

SIGNALS.
Penn. Steel Co., 208 So. 4th St. Phila., Pa.

SNOW GUARDS.
Folsom Snow Guard Co., 33 Lincoln St., Boston, Mass.

SNOW PLOWS.
Leslie Brothers Mfg. Co., Paterson, N. J.

STAND PIPES FOR WATER WORKS.
Tippett & Wood, Phillippsburg, N. J.

STAY-BOLT IRON.
B. M. Jones & Co., 13 Oliver St., Boston, Mass.

STAY-BOLT TAPS.
Cleveland Twist Drill Co., Cor. Lake and Kirkland Sts., Cleveland, O.
J. T. Connelly, Milton, Pa.
Stow Flexible Shaft Co., Binghamton, N.Y.

STEAM ENGINES & BOILERS.
C. P. Allis & Co., Milwaukee, Wis.
Frick Co., Waynesboro, Pa.
H. J. McKeown, 196 E. Front St. Cincinnati, O.
Robert Poole & Son Co., Baltimore, Md.

STEAM HAMMERS.
Bell Steam Engine Co., Buffalo, N. Y.
Cleveland Ship Building Co., Cleveland, O.
Dudgeon, R., 24 Columbia St., New York.
Bement, Miles & Co., Philadelphia, Pa.
Wm. Sellers & Co., Philadelphia, Pa.

STEAM PUMPS.
Blake, Geo. F. Mfg. Co., 95 Liberty St., N. Y.
Davidson, M. T., 43 Keap St., Brooklyn, N. Y.
Dean Bros. Steam Pump Works, Indianapolis, Ind.

STEAM SEPARATORS.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.
Mosher, C. D., 1 Broadway, N. Y.

STEAM SHOVELS.
Vulcan Iron Works, Toledo, O.

STEAM SPECIALTIES.
CrosbySteamGage&ValveCo., Boston, Mass.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.

STEAM TRAPS.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.

STEEL.
B. M. Jones & Co., 13 Oliver St., Boston, Mass.
Chester Steel Castings Co., Chester, Pa.

STEEL CASTINGS.
Chester Steel Castings Co., Chester, Pa.
Dutcher Co., J. A. & P. E., Milwaukee, Wis.

STEEL FORGINGS.
Bethlehem Iron Co., So. Bethlehem, Pa.
Cambria Iron Co., 218 So. Fourth St., Philadelphia, Pa.
Penn. Steel Co., 208 So. Fourth St., Phil'a, Pa.

STEEL RAILS.
Bethlehem Iron Co., So. Bethlehem, Pa.
Cambria Iron Co., 218 So. Fourth St., Philadelphia, Pa.
Pennsylvania Steel Co., 208 So. Fourth St., Philadelphia, Pa.

STEEL TIES.
Chester Steel Castings Co., Chester, Pa.

STEEL TIRES.
Krupp, Thos. Prosser & Son, 15 Gold St., N.Y.
Latrobe Steel Works, Latrobe, Pa.

STEEL-TIRED WHEELS.
Allen Paper Car Wheel Co., Chicago, Ill.
Ramapo Wheel & F'y Co., Ramapo, N. Y.
A. Whitney & Sons, Philadelphia, Pa.

STEEL WHEELS.
Chester Steel Castings Co., Chester, Pa.

STREET RAILS.
Cambria Iron Co., 218 So. Fourth St., Philadelphia, Pa.

SWITCHES.
Carlisle Mfg. Co., Carlisle, Pa.
New York Frog & Switch Co., Madison and 15th Sts., Hoboken, N. J.
Ramapo Iron Works, Hillburn, N. Y.
Pennsylvania Steel Co., 208 So. Fourth St., Philadelphia, Pa.
Weir Frog & Switch Co., Cincinnati, O.

TAPS AND DIES.
Armstrong Mfg. Co., Bridgeport, Conn.

TECHNICAL SCHOOLS.
Rensselaer Polytechnic Inst., Troy, N. Y.
Correspondence School of Industrial Science Scranton, Pa.

TESTING AND INSPECTION.
Hunt & Clapp, 116 Water St., Pittsburg, Pa.
Robert W. Hunt & Co., Rookery B'ld'g, Chicago, Ill.

TESTING MACHINES.
Tinius, Olsen & Co. 500 N. 12th St., Philadelphia, Pa.
Riehle Bros. Testing Mach. Co., 9th St., above Master, Philadelphia, Pa.
Wm. Sellers & Co., Philadelphia, Pa.

TIE PLATES.
Q. & C. Co.

TOOLS.
Armstrong Bros. Tool Co., 76 Edgewood Ave., Chicago, Ill.
Wiley & Russell M'f'g Co., Greenfield, Mass.

TRACK TOOLS.
Eureka Nut Lock Co., Pittsburg, Pa.

TRUCKS.
Fox Solid Pressed Steel Co., Western Union Building, Chicago.
Shaw, Willis, 416 New York Life Building, Chicago, Ill.

TUBE EXPANDERS.
Dudgeon, R., 24 Columbia St., New York.

TURBINES AND PUMPS.
Robert Poole & Son Co., Baltimore, Md.

TURNBUCKLES.
Cleveland City Forge & Iron Co., Cleveland, O.

TURNTABLES.
Wm. Sellers & Co., Philadelphia, Pa.
Tippett & Wood, Phillippsburg, N. J.

TWIST DRILLS.
Cleveland Twist Drill Co., Cleveland, O.

VALVES.
Ross Valve Co., Troy, N. Y.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.

VENTILATORS.
Palmer Ventilating Co., Bowdoin St., Boston, Mass.

VISES.
Merrill Brothers, Brooklyn, N. Y.

WATER PRESSURE REGULATORS.
D'Este & Seeley Co., 29 Haverhill St., Boston, Mass.

WATER TANKS.
Automatic Water Tank Co. 143 Liberty St., New York.

WATER WHEELS.
Rob't Poole & Son Co., Baltimore, Md.

WATER-TUBE BOILERS.
Abendroth & Root Mfg. Co., 28 Cliff St., New York.
Adams Boiler Co., Cleveland, O.
Almy Water-Tube Boiler Co., Providence, R.
Babcock & Wilcox Co., 29 Cortlandt St., New York.
Boyer's Sons, L., 90 Wall St., New York.
Finlayson Water-Tube Boiler Co., P. O. Box 128, Detroit, Mich.
Mosher, C. D., 1 Broadway, New York.
Moyes, L. M., 411 Walnut St., Phila., Pa.
Robert Poole & Son Co., Baltimore, Md.
Roberts Water-Tube Boiler, 39 Cortlandt St., New York.

WIRE AND WIRE ROPE.
Trenton Iron Co., Trenton, N. J.

WOOD PRESERVING.
Lehigh Valley Creosoting Works, 1 Broadway, New York.

WOOD-WORKING TOOLS.
J. A. Fay & Co., Cincinnati, Ohio.
The Egan Co., Cincinnati, O.

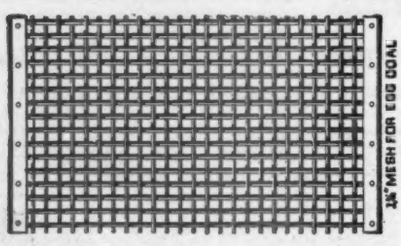
WRENCHES.
Armstrong Mfg. Co., Bridgeport, Conn.
Chester Steel Castings Co., Chester, Pa.
Coes Wrench Co., Worcester, Mass.
Wright Wrench Co., Worcester, Mass.

WROUGHT IRON CASTINGS.
Dutcher Co., J. A. & P. E., Milwaukee, Wis.

"HUNT" SYSTEM

COAL HANDLING MACHINERY.

COAL POCKET WOVEN SCREEN.

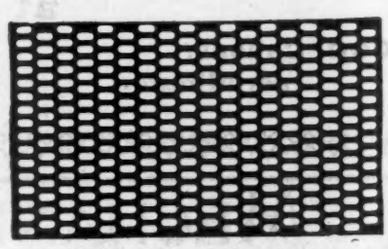


Coal Pockets designed and equipped with the most economical machinery.

Plans and Estimates furnished on application.
Send for Catalogue.

C. W. HUNT COMPANY,
45 Broadway, N. Y.

COAL POCKET PLATE SCREEN.



The Mechanical Engineer's Pocket Book. *Second edition, by D. Kinnear Clark, containing Rules, Tables, etc. Price, $3.00.*

Address **M. N. FORNEY, 47 Cedar St.**

We have the following A1 Second-Hand Machinery in stock:

27 in. x16 ft. Otis Engine Lathe, C. Rest, P. C. Feed, extra heavy tool, complete.
31 in. x8 ft. Pratt & Whitney Engine Lathe, C. Rest, P. C. Feed and Taper attachments; has 12 and 18 in. chucks fitted; in fine order.
26 in. x10 ft. D. W. Pond Engine Lathe, C. Rest and P. C. Feed; has 18 in. 4-jaw Universal Horton' Chuck fitted; good as new.
20 in. x7 ft. 6 in. Ames' heavy pattern Engine Lathe, Plain Gib Rest and Grinding attachment, 12 in. and 6 in. chucks fitted; in fine order.
26 in. x12 ft. Grant & Bogert Engine Lathe, C. Rest, P. C. Feed, with 15 in. 4-jaw combination Westcott Chuck fitted. This lathe is good as new and a bargain.
11 in. Graves' Crank Shaper, with vise and all attachments; good order.
18 in. x8 ft. Michel Plain Turning Lathe, R. & F. Rest, in good order.

Send for complete lists of New and Second-Hand Machinery

PRENTISS TOOL & SUPPLY CO.,

Chicago: 62-64 South Canal Street. 115 LIBERTY ST., NEW YORK.

ROSS VALVE CO.,

OAKWOOD AVE., TROY, N. Y.

Manufacturers of

Ross Pat. Press-Regulators

FOR

WATER, STEAM OR AIR.

Ross Water Engines

FOR

PUMPING CHURCH ORGANS.

Send for Circulars.

ALPHABETICAL INDEX TO ADVERTISERS.

dwoth Root. M'f'g Co..... xiv
ne Machinery Co..... xxvii
ms Boiler Co..... xii
kinson, Robert Co..... xxxii
n Paper Car Wheel Co..... xxix
k, Edward P. & Co..... xiii
ton Mfg. Co..... xxx
y Water-Tube Boiler Co..... xii
neider, Theodore & Sons..... xviii
erican Brake Co..... xxxv
erican Engineer..... xxiii
erican Heat Insulating Co..... xxiv
k, Mining & Milling Mach'y Co. xxxiv
mstrong Bros. Tool Co..... i
mstrong Mfg Co..... xxvii
tomatic Water Tank Co..... vii
er, Henry C..... v
bcock & Wilson Co..... xiv
ker, W. C..... xxxiii
dwin Locomotive Works..... ix
ll Steam Engine Co..... xxiv
ement, Miles & Co..... xvii
hlehem Iron Co. xxi
g Four Railroad..... xxvii
ke, Geo. F. M'f'g Co..... xv
ss, E. W. & Co..... xxvi
rks..... xxxi
ston Belting Co..... vii
yer's Sons, L..... xii
bit Metal Co..... ix
idgeport Safety Emery Wheel Co. xxiv
oks Locomotive Works..... ix
own Hoisting and Conveying Ma-
chine Co..... iii
llard Machine Tool Co..... xxxvi
sh Cattle Guard Co..... xxxiv
yers Machine Co., The John F... xxv
lly Manufacturing Co..... xxvi
mbria Iron Co..... xviii
pital Machine Tool Co..... v
rlisle Manufacturing Co..... xxxiii
use, L. C. & Co..... xxxii
ester Steel Castings Co..... xxviii
i, Bur. & Quincy R. R..... xxii
icago Pneumatic Tool Co..... xv
ncinnati, Ham. & Dayton R.R.... ....
ncinnati Screw and Tap Co..... i
yton Air Compressor Works.... xvi
veland City Forge & Iron Co.... i
veland, Cincinnati, Chicago & St.
Louis R. R xxvii
veland Ship Building Co.... xv, xxxvi
Cleveland Twist Drill Co..... xxxvi
Coes Wrench Co..... xxiv
Conant, Jas. S. & Co..... xxi
Connelly, J. T..... x
Consolidated Car Heating Co..... xix
Continental Iron Works..... xiv
Contractors' Plant Mfg. Co..... xxv
Correspondence School of Industrial
Science..... xxx
Craig-Reynolds Foundry Co..... xxi
Crook, W. A. J. Bros. Co..... xxv
Crosby Steam Gage & Valve Co.... x
Crown Smelting Co..... xvi
Damascus Bronze Co..... ix
Davidson, M. T..... xv
Dean Bros. Steam Pump Co..... xv
Deane, E. L. xiii
DeKalb Fence Co..... xxxiv
D'Este & Seeley Co..... ii
Detroit Graphite Mfg. Co..... xxix
Detroit Lubricator Co..... viii
Devoe, F. W. & Co..... xix
Dickerman Emery Wheel and Ma-
chine Co..... xxiv
Diamond Machine Co..... v
Dixon, Joseph, Crucible Co..... xi
Dreher Mfg. Co..... xi
Dudgeon, R..... xvi
Dunkirk Engineering Co..... xxiv
Dutcher Co., J. A. & P. E..... xxvii
Egan Co., The..... xxvi
Ellwood, I. L. Manufacturing Co.. xxxiv
Eureka Nut Lock Co..... iv
Evans, Louis P..... xxi
Fay, J. A. & Co..... xxvi
Felton, Sibley & Co.. xlx
Ferracute Machine Co..... xix
Fitchburg Railroad Co..... xvi
Folsom Snow Guard Co..... v
Forbes, W. D. & Co..... xvii
Forney Car Seats..... xxxii
Forney, M. N..... viii
Fowler, Geo. L. xxi
Fox Solid Pressed Steel Co..... xxxiii
Frick Co..... xiii
Gaudron, Auguste E..... xxii
Gesner, G. W..... xxviii
Gibbons, Charles D..... xxviii
Gooch, Chas. J.... xxi
Gould Coupler Co..... xxix
Gould & Eberhardt..... xxvi
Harlan's English Varnishes..... xxxvi
Harlan & Hollingsworth..... xxx
Harrington & King..... ii
Harrisburg Foundry & Machine W'ks xiii
Howard Iron Works..... xxvii
Hubbell, Harvey..... xxvii
Hunt, C. W. Co..... vi
Hunt & Clapp..... xviii
Hunting, Alfred A..... xxi
Hutchins & Sons..... xxxvi
Johnston Car-Coupling Co..... xxviii
Jones, B. M. & Co..... xxxvi
Kalamazoo Railroad Velocipede Car
Co..... xxi
Keuffel & Esser Co..... xxvii
Krupp, Fried..... viii
Lake Shore & Michigan Southern R'y xxxiii
Latrobe Steel Works..... xxix
Leach, Henry L..... x
Lehigh Valley Creosoting Works... xii
Leslie, J. S..... viii
Lidgerwood Manufacturing Co.... iii
Long & Allstatter Co..... xxvi
McConway & Torley Co..... xxviii
McKeown, H. J..... xxv
McSherry Mfg. Co xxx
Mason, Volney W., & Co xxiv
Merrill Bros..... i, xxiv
Mosher, C. D..... xii
Mowry Car Wheel Works xxxiii
Moyes, L. M..... xv
Mundy, J. S..... xxv
Nathan Mfg. Co..... viii
National Malleable Castings Co... iii
Newburg Ice Machine & Engine Co. xiii
N. Y. Central & Hudson River R.R. xxi
New York Frog & Switch Co..... xxxiii
Norton, A. O..... xxxvi
Norwalk Iron Works Co..... xvi
Olsen, Tinius & Co..... xviii
Page Woven Wire Fence Co..... xxxiv
Palmer Ventilator Co..... xxii
Paschke, Van Horne & Kelley..... xxi
Pennsylvania Railroad..... xxi, xxii
Pennsylvania Steel Co..... xxxiii
Pittsburgh Locomotive Works..... ix
Pittsburgh Testing Laboratory..... xviii
Poole, Robert, & Son Co..... xvii
Pratt & Whitney Co xxvi
Prentiss Tool & Supply Co..... vi
Prosser, Thomas & Sons..... viii
Q. & C. Co..... xviii
Ramapo Iron Works..... ii
Ramapo Wheel & Foundry Co..... ii
Rensselaer Polytechnic Institute... xix
Restauro Manufacturing Co..... xxxii
Richard, John..... xv
Richards, I. P..... i
Richmond Loco. & Mach. Works... x
Riehle Bros. Testing Mach. Co.... x, xxx
Roberts, Throp & Co..... i
Roberts Water-Tube Boiler..... xix
Rogers Locomotive Co..... x
Rosenbaum, Wm. A..... xxi
Ross Valve Co..... vi
Rue Mfg. Co..... xix
Safety Car Heating & Light. Co..... xxxii
St. Charles Car Co..... xxx
Scarritt Furniture Co..... xxxii
Schenectady Locomotive Works... xi
Sellers, William & Co..... xviii
Shaw, Willis xiii
Sheffield Car Co..... i
Signal Oil Works, Ltd..... xl
Sooysmith & Co..... xxi
Southern Railway Co..... xxii
Springfield Manufacturing Co..... xxv
Standard Coupler Co..... xviii
Sterling Emery Wheel Mfg. Co.... xxxi
Stevens, H. L. C..... xiii
Stow Mfg. Co..... xxvii
Thurman Fuel Oil Burner Co..... iv
Timolat, James G..... xxxvi
Tippett & Wood..... xxv
Transport..... ....
Trenton Iron Co..... iii
U. S. Metallic Packing Co..... xi
Valentine & Co xix
Van Nostrand, D. Co..... iv
Vulcan Iron Works..... xxv
Warren Chemical & Mfg. Co..... iv
Wason Mfg. Co..... xxx
Watson, H. F., Co. xxiv
Watson & Stillman..... xvi
Weber Co., F..... v
Weir Frog & Switch Co... xxxiii
Westinghouse Air Brake Co..... xxxv
Westinghouse Machine Co.... xii
Whiting Foundry Equipment Co... xxxvi
Wiley & Russell M'f'g Co..... xxvii
Wilson Bros. & Co..... xxi
Worcester Machine Screw Co..... xxvii
Wright Wrench Co..... xxviii
Youngstown Bridge Co..... xxv
Youngstown Car Mfg. Co..... xxx

Automatic Water Tanks

SAVE ALL PUMPING-EXPENSE

at R. R. Water Stations.

1000 Gallons. per Minute.

The Automatic Water Tank Co., 143 Liberty Street, New York.

MECHANICAL RUBBER GOODS

OF EVERY DESCRIPTION AND FOR ALL PURPOSES.

RUBBER BELTING, HOSE, PACKING, GASKETS, VALVES, MATS, MATTING, STEP TREADS, RUBBER CEMENT, SPRINGS, TUBING, WASHERS.

Air Brake Hose.

Car Heating Hose.

BOSTON BELTING CO.,

JAMES BENNETT FORSYTH, M'f'g Ag't & Gen. M'g'r.

256-258-260 Devonshire St., Boston.
14 N. 4th St., Philadelphia.
109 Madison St., Chicago.
9th St. & Washington Ave., St. Louis.
100 Chambers St., New York.
201-5 W. Pearl St., Cincinnati.
380 East Water St., Milwaukee.
24 Fremont St., San Francisco.

THE LESLIE KINDLER.

A SWEEPING RECORD.

Over Fifty Thousand Fires Kindled
For Less Than **2 CENTS PER FIRE.**

Records from six railroads during the past twelve months show that through the use of the LESLIE AUTOMATIC FIRE KINDLER cost of kindling their fires has not varied more than the smallest fraction of a cent per fire, month after month, and that

One Car Tank of 6,000 Gallons of Crude Oil
WILL KINDLE MORE FIRES THAN
107 Car Loads or 750 Cords of Wood.

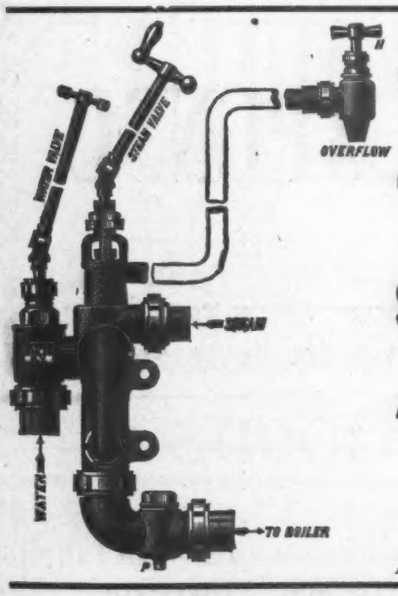
For full particulars, address J. S. LESLIE, Paterson, N. J.

Catechism of the Locomotive.

New Edition, Revised and Enlarged.

The book has been brought up to the most recent American practice, and is written in a plain a simple style and without any mathematics excepting arithmetic. It is for sale in the office of t AMERICAN ENGINEER AND RAILROAD JOURNAL, 47 Cedar Street, New York, a will be sent by mail, prepaid, on receipt of the price, $3.50. Address

M. N. FORNEY, 47 CEDAR STREET, NEW YOR



THE NEW
"Nathan" and Monitor Injectors
FOR LOCOMOTIVES.
"Nathan" Sight-Feed Lubricators
For LOCOMOTIVE CYLINDERS and AIR-BRAKES.
STEAM FIRE EXTINGUISHERS
For SWITCHING and YARD ENGINES.
Boiler Washers, Rod and Guide Oil Cups, Etc.,

NATHAN MANUFACTURING CO.,
92 & 94 Liberty Street, New York.
SEND FOR ILLUSTRATED CATALOGUE.

The Most Easy-Working Locomotives are those that are Equipped with the DETROIT SIGHT FEED LUBRICATORS.
Our Catalogue Tells Why. Send for it.
DETROIT LUBRICATOR CO.,
Detroit, Mich.

CATECHISM OF THE LOCOMOTIV

Sent by mail up receipt of the price $3.50

ADDRESS
M. N. FORNE
47 Cedar St.
N. Y.

KRUPP STEEL TIRES

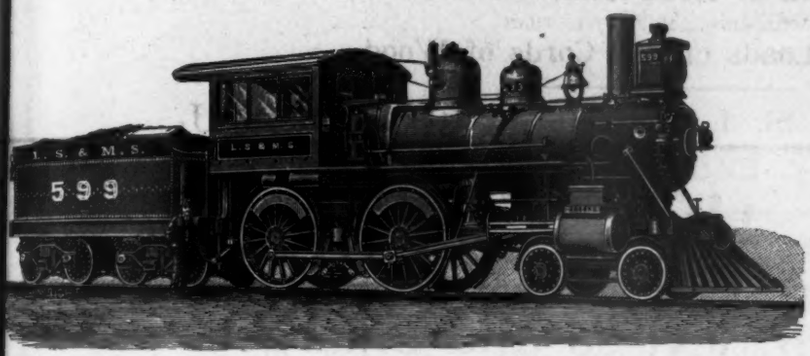
On Locomotive Driving-Wheels and on Steel-Tired Wheels give the Bes Results for Every Variety of Service.

THOMAS PROSSER & SON,
15 GOLD STREET, NEW YORK.

DAMASCUS BRONZE FOR LOCOMOTIVE, CAR AND ROLLING MILL BEARINGS.
MANUFACTURERS OF GLOBE BRAND PHOSPHOR BRONZE IN ALL GRADES.
A. CALLAN — EQUAL TO ANY IN THE WORLD — BABBITT METALS FOR ELECTRICAL, STATIONARY AND MARINE MACHINERY — J & H. TAYLOR,
30 OLD COLONY BUILDG CHGO ILL — DAMASCUS BRONZE CO. PITTSBURGH, PA FRANK SCOTT, TREAS. — MONTREAL, CAN.

BROOKS LOCOMOTIVE WORKS,

DUNKIRK, N. Y.



Builders of Locomotive Engines

OF ANY REQUIRED SERVICE,

From our own Designs or those of Purchasers.

Perfect Interchangeability and all work fully guaranteed.

COMPOUND LOCOMOTIVES

For Passenger and Freight Service.

R. J. GROSS, Vice-Pres't.
T. M. HEQUEMBOURG, Sec'y.

M. L. HINMAN, Pres't and Treas'r.
F. H. STEVENS, Ass't to Pres.

DAVID RUSSELL, Superintendent.
H. TANDY, Ass't Sup't.

PITTSBURGH LOCOMOTIVE WORKS,

P. O. ADDRESS, PITTSBURGH, PA.

Builders of First-Class

WORKS, 430 BEAVER AVE. ALLEGHENY, PA.

HEAVY AND LIGHT LOCOMOTIVES,

Standard and Narrow Gauge for Passenger and Freight Service.

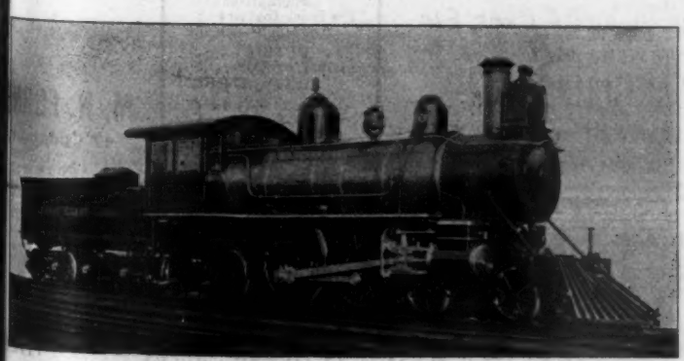
WILSON MILLER, President and Treasurer.

PITTSBURGH, PA.

D. A. WIGHTMAN, Superintendent

CORRESPONDENCE SOLICITED.

ESTABLISHED 1831. **BALDWIN LOCOMOTIVE WORKS** ANNUAL CAPACITY, 1,000.



Single Expansion & Compound Locomotives

: : Broad and Narrow Gauge Locomotives : :
Mine and Furnace Locomotives Compressed Air Locomotives

: : Steam Cars and Tramway Locomotives : :
Plantation Locomotives Oil-Burning Locomotives

Adapted to every variety of service, and built accurately to gauges and templates after standard designs or to railroad companies' drawings. Like parts of different engines of same class perfectly interchangeable.

Electric Locomotives and Electric Car Trucks with Approved Motors.

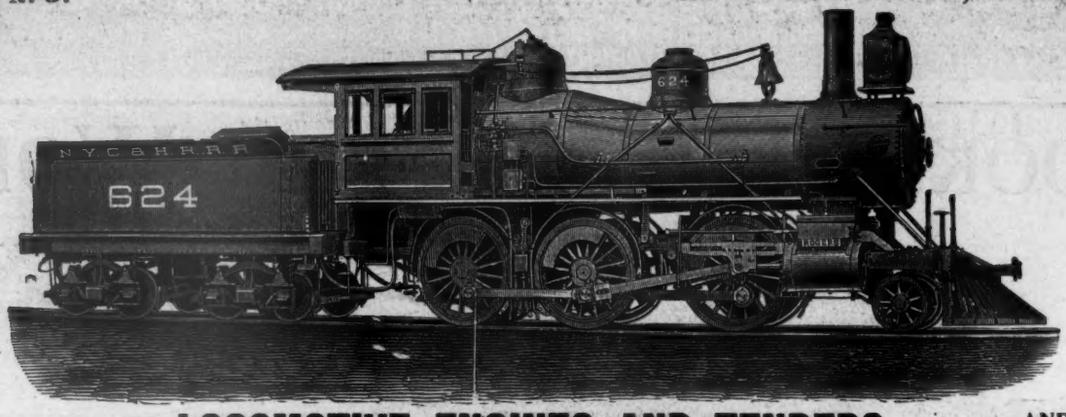
BURNHAM, WILLIAMS & CO., Philadelphia, Pa., U. S. A.

New Contracts for 1896

BRADY METAL COMPANY, 100 Broadway, New York
are prepared to submit new form of contract covering composition Engine and Car Castings of all patterns. Eleven of the fastest passenger trains run in America are equipped with our metals. Excellent References furnished.

ROGERS LOCOMOTIVE COMPANY,

PATERSON, N. J. NEW YORK OFFICE, 44 Exchange Pla



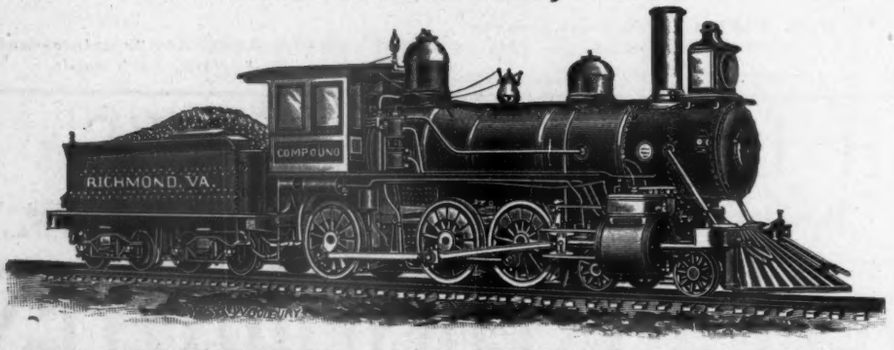
MANUFACTURERS OF **LOCOMOTIVE ENGINES AND TENDERS,** AND OTHER RAILROAD MACHINER

R. S. HUGHES, President. *G. S. LONGBOTTOM, Sec'y.* *G. E. HANNAH, Treas.* *REUBEN WELLS, Supt.*

ESTABLISHED 1865.

Richmond Locomotive and Machine Works,

RICHMOND, VA.



LOCOMOTIVES FOR EVERY SERVICE.

IMPROVED PNEUMATIC

TRACK-SANDIN

Apparatus for Locomotives.

HENRY L. LEACH,

176 Huron Ave., No. Cambridge, Ma

The Locomotive Engin

and its Development.

By CLEMENT E. STRETTON, C.

Third edition ; price $1.00.

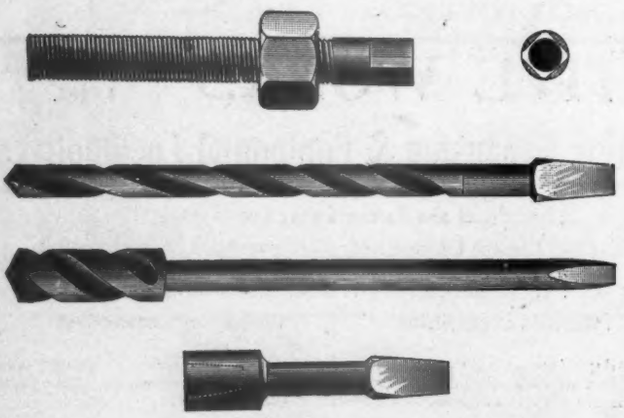
Sent by mail postpaid.

M. N. FORNEY, 47 Cedar Street, N.

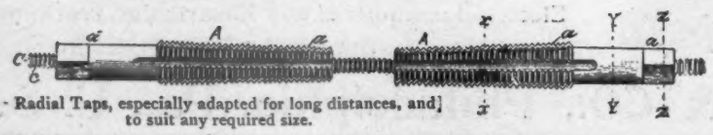
La Machine Locomotive. By EDOUARD SAUVAGE. PARIS.

A description of the parts and functions of the Locomotive. Printed in French—Illustrated. Price, $1.25.

Address M. N. FORNEY, 47 Cedar St., New York.



Patent Drills for Removing Old or Broken Staybolts from the Fireboxes of Locomotives without removing the Drivers, Frames, or otherwise disturbing any of the parts of the Engine.



Radial Taps, especially adapted for long distances, and to suit any required size.

Address: J. T. CONNELLY, Milton, Pa.

CROSBY

POP SAFETY VALVES,

MUFFLED and PLAIN

IMPROVED

Steam Gages.

Single Bell

Chime Whistles.

All Standard Goods.

Specify these and thus secure a perfect equipment for a locomotive.

Patent Gage Tester.

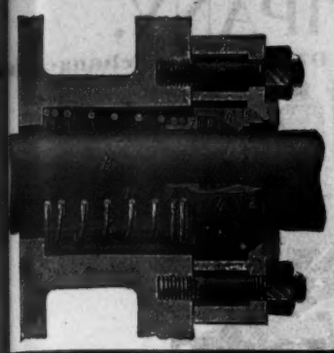
CROSBY STEAM GAGE VALVE CO.

BOSTON, MASS.

Branches: New York, Chicago and London.

Advertise in and Subscribe for **QUARTERLY DIGEST** OF PHYSICAL TESTS.—Riehle Bros. Testing Machine Co., Publishers & Proprietors, *9th & Master Sts., Phila.*

Robie Jacks, Hydraulic Pumps and Presses. Riehle Bros. Testing Machine Co., 9th & Master Sts., Philadelphia. New York Office, 93 Liberty S



U. S. Metallic Packing Co.,

PERFECTED PACKING

For LOCOMOTIVES, MARINE AND STATIONARY ENGINES.

IN USE ON OVER 350 RAILROADS.

MANUFACTURERS AND SOLE R.R. AGENTS FOR THE

Gollmar Locomotive Bell Ringer.

GENERAL OFFICE: 610 Bullitt B'ld'g, Philadelphia, Pa. WORKS: 427 N. 13th St., Philadelphia, Pa.

St. Louis: 32 Laclede B'ld'g. San Francisco: 130 Main St. Montreal: 751 Craig St.

It has been demonstrated beyond question that

DIXON'S PURE FLAKE GRAPHITE

Is as necessary to the proper equipment of an engine as a monkey wrench or an oil can. It positively saves engine and valve oil, and prevents and cures hot pins and bearings.

SEND FOR SAMPLE AND TESTIMONY OF EXPERTS. JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.

Important to Railroad Managers and Master Mechanics.

Sibley's Perfection Valve Oil.

Insures perfect lubrication insured and valve freedom guaranteed from corrosion of cylinders and destruction of steam joints by fatty acid.

In exclusive use on 50 Railroads.

Make exclusive specialty of the manufacture of Valve and Signal Oil for Railroad use.

References and Prices furnished upon application.

SIGNAL OIL WORKS (Limited), Franklin, Pa.

J. C. SIBLEY, President.

DREHER'S RAILROAD CAR COMPOUND.

The Best CAR AXLE LUBRICANT in existence.

Used in the BEST RAILWAY SERVICE in the UNITED STATES and CANADA.

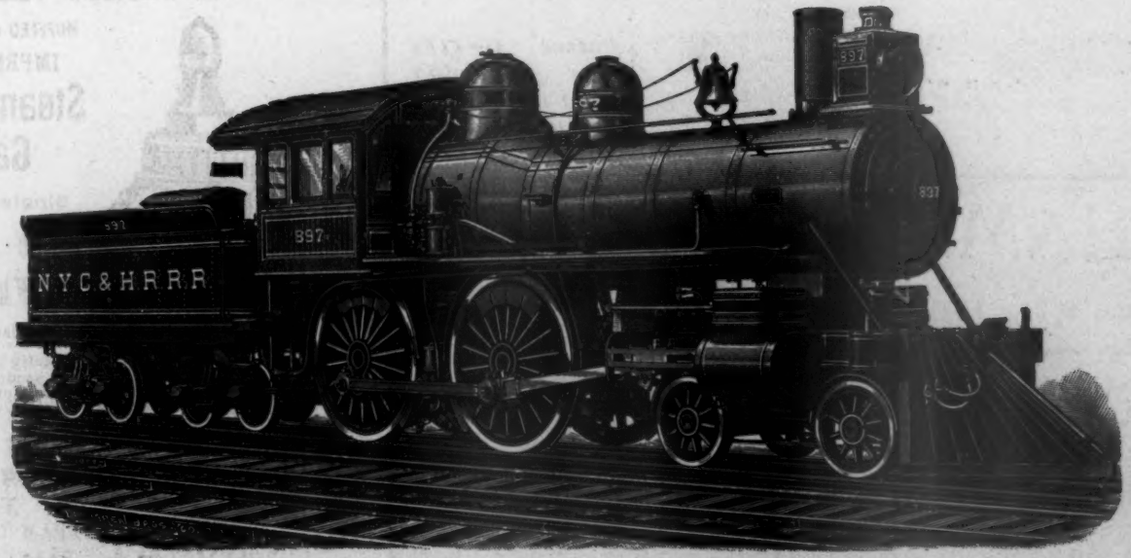
MANUFACTURED SOLELY BY

THE DREHER MFG. CO.,

249 FRONT STREET, N. Y. CITY.

Schenectady Locomotive Works,

SCHENECTADY, N. Y.



Locomotives of Standard Design for all Classes of Service, or from Designs furnished by Railroad Companies.

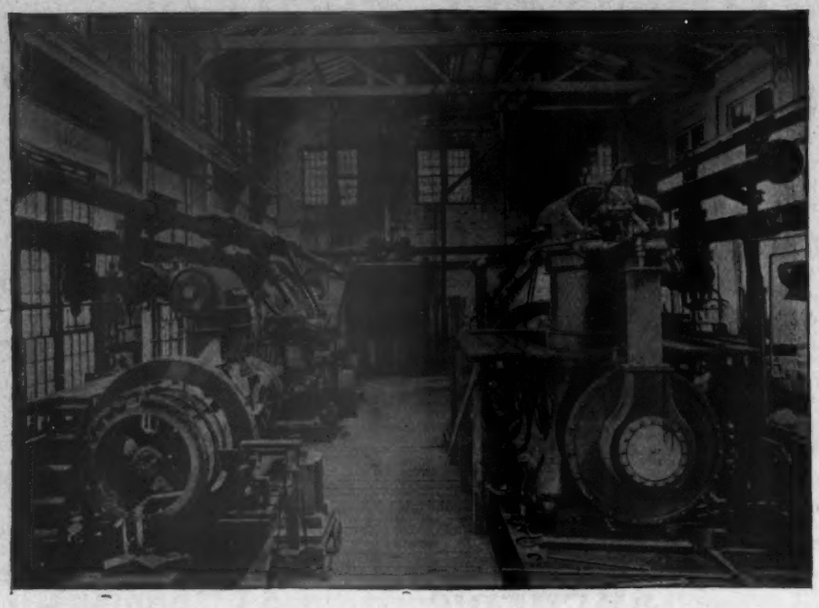
COMPOUND LOCOMOTIVES,

Showing an Economy of 15 to 25 Per Cent. in Fuel and Water.

EDWARD ELLIS, President.
WM. D. ELLIS, Vice-Pres. and Treas.

ANNUAL CAPACITY, 400.

ALBERT J. PITKIN, Superintendent.
A. P. STRONG, Secretary.



TESTING ROOM.

ALL

Westinghouse Engines

FROM THE

5 H. P. "Junior" and "Standard"

TO THE

700 H. P. Compound

ARE SUBJECTED TO

Rigid Mechanical and Economy Test

BEFORE LEAVING THE FACTORY!

If this subject is of interest, we will send you a lit circular which explains it more fully.

The Westinghouse Machine Company,

PITTSBURG, PA., U.S.A.

The Adams Feed Water Heater and Purifier.

Guaranteed to be equal to any Heater made and the lowest in price.

THE BRITTON ROLLING MILL CO.

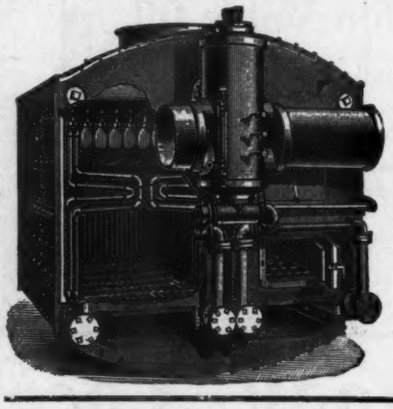
CLEVELAND, O., May 4, 1892.

DEAR SIRS:—I would state that the Feed Water Heater that you put in a short time since is entirely satisfactory. You stated, under the peculiar circumstance of my exhaust being so variable, that the temperature of water would be about 200 degrees. It is doing much better than you claimed, as the temperature stands from 208 to 212 degrees when engine is running. The general construction of Heater is so simple that it will never require any repairs and will last until the shell rusts out.

Yours truly, J. W. BRITTON, President.

For circulars, prices, guarantees, etc., address

ADAMS BOILER CO., Cleveland, O.



ALMY

Water Tube Boiler

ADAPTED FOR STATIONARY OR MARINE WORK.

ALMY WATER TUBE BOILER CO.,

PROVIDENCE, R.

THE LEHIGH VALLEY

CREOSOTING WORKS,

WORKS: Perth Amboy, N. J.

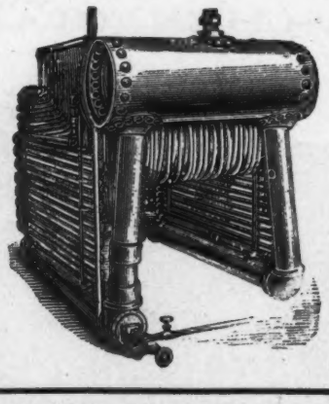
OFFICE: Rooms 136 and 137 Washington Building, No. 1 Broadway, New York.

ROLLIN H. WILBUR, Pres.

WALTER G. BERG, Engineer. H. COMER, Supt.

Lumber, Piling and Ties creosoted with **DEAD OIL OF COAL TAR.** Creosoted timber furnished. Capacity, 400,000 ft. B. M. per month Cylinders 80 ft. long. Direct water and rail communication.

BOYER'S PATENT SECTIONAL WATER TUBE BOILER.



These rapid steaming Boilers require less room, occupy less space in width height and length; weigh less than any other.

Have short, perfect circulation, no dead ends, no joints in the fire, and any engineer can get at all parts of it.

The Steam Yacht "Rex," having 25 sq. ft. grate surface and 1000 sq. ft. heating surface, steamed 144 miles on 1000 lbs of coal.

Address:

L. BOYER'S SONS,

90 Wall St., New York City.

STEAM. By WM. RIPPER.

202 pages. Price 80c.

Address M. N. FORNEY, New York.

Boiler Makers

will find a valuable assistant in

Courtney's "Boiler Maker's Assistant,"

Revised by D. K. CLARK,

Price, 80c.

Machinists

can get many hints from

Shelley's "Work Shop Appliances,"

$1.50.

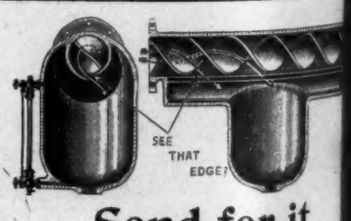
Sent postpaid on receipt of price by

M. N. FORNEY, 47 Cedar St., N. Y.

Do You Use Steam?

My **Treatise on the Steam Separator** tells about **Separators** in general and the **MOSHER** in particular.

THE INFORMATION IT CONTAINS WILL BE VALUABLE TO YOU.



Send for it. Free . . .

CHARLES D. MOSHER, No. 1 Broadway, New York

CHEMISTS, METALLURGISTS and IRON MANUFACTURERS

Will be interested in the new series of articles,

CHEMISTRY APPLIED TO RAILROADS,

By C. B. DUDLEY and F. N. PEASE, Chemists to the Penna. R. R. Commenced in January, 1893, of the American Engineer.

Subscription, $2.50 per year.

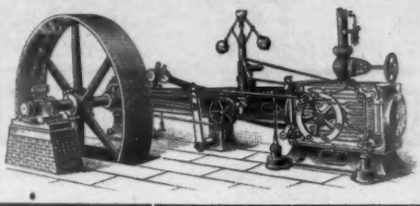
Monthly Parts, 25 cts. Bi-weekly Parts, 10 cts.

Newburg Ice Machine & Engine Co.

SUCCESSORS TO

WHITEHILL ENGINE & PICTET ICE MACHINE CO.

Office and Works, NEWBURG, N. Y.



WHITEHILL CORLISS ENGINES

Simple, Compound and Condensing

Ice Making and Refrigerating Machinery

Iron and Brass Castings

H. L. C. STEVENS, SUCCESSOR TO

STEVENS & MORRIS,

Photo-engravers for all Purposes.

HALF-TONE A SPECIALTY.

Engravers for the American Engineer and Railroad Journal

20 COLLEGE PLACE, NEW YORK.

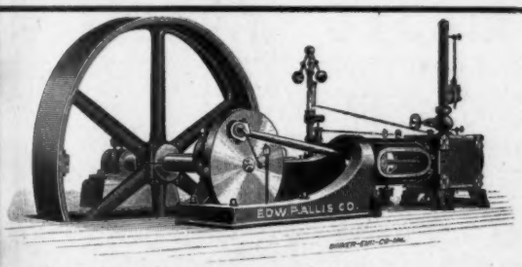
STEVENS & MORRIS PHOTO-ENGRAVERS & DESIGNERS 20 College Place—or Park Place NEW YORK

WILLIS SHAW.

Steam Pumps, Boilers, Hoisting Engines, Mine Cars, Trucks, Barrows, Corrugated Roofing, Mill, Mining and Contractors' Supplies.

Office, 416 New York Life Building,

Write for Prices. CHICAGO, ILL.



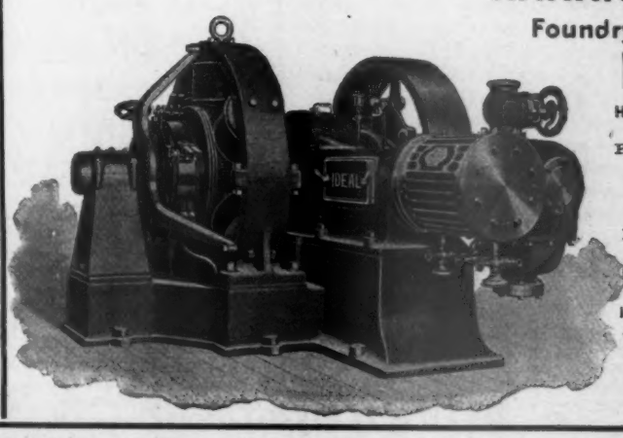
Reynold's Corliss Engines

Reynold's Patented Vertical Boilers

Air Compressors

Special Engines for Street Railways

The EDWARD P. ALLIS COMPANY, Milwaukee, Wis.



HARRISBURG

Foundry and Machine

WORKS

HARRISBURG, PA.

Harrisburg Ideal Direct-Connected Engine. . . .

THE IDEAL

For cleanliness and quiet running.

Selling Agents:

W. R. FLEMING & CO., New York. Boston, Phila.

H. E. BALDWIN, Cincinnati.

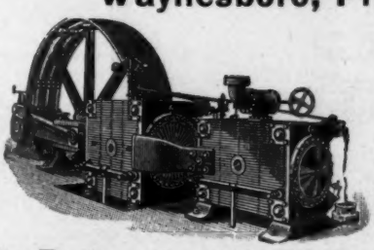
WALLACE STEBBINS, Baltimore.

FRICK COMPANY, Engineers,

Waynesboro, Franklin Co., Penn.

All Styles, 40 to 2,000 HORSE POWER.

Send for CIRCULAR 1895.



ECLIPSE Corliss ENGINES

Plain Corliss Engines, Cross or Tandem Compound; Triple Expansion and Vertical Corliss Engines.

Corliss Engines of any style, specially adapted for Electric, Railway and General Work. Rolling Mills and Factories, etc. Best regulation and economy guaranteed. Also Builders of

Steam Boilers and High Speed Automatic Engines

We solicit the furnishing of Steam Plants complete, including everything.

ICE-MAKING AND Refrigerating Machinery.

Complete plants for Ice-making, and Refrigeration for Breweries, Packing-Houses, Cold Storage, etc. Refrigerating Capacities: 2 to 300 tons. Ice-making Plants: 5 to 1,000 tons per day.

SEND FOR CIRCULAR 1895.

A TREATISE ON STEAM BOILERS,

By ROBERT WILSON.

4½x7 in. 328 pages. Price, $2.50.

This book is by a practical man, and is written so that any one can understand it easily. It has little or no mathematics, and few engravings, but is a very excellent treatise on a subject, in the elucidation of which practical experience is of more value than scientific theories.

M. N. FORNEY, 47 Cedar Street, N. Y.

DEANE'S PATENT ADJUSTABLE T-SQUARES.

"LIMITED," "UNLIMITED" CLIMAX.

BEST T-SQUARES MADE.

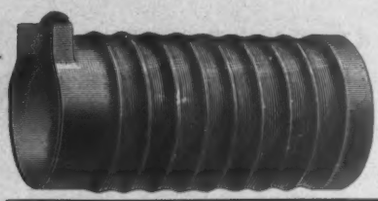
For sale by dealers in all the principal cities. Circulars on application. Samples by mail postpaid.

24-inch Limited Adjustment, Nickel Trimmings, ... $1.00

24-inch Unlimited " " " 1.50

E. L. DEANE, Sole Manufacturer, Holyoke, Mass.

MORISON SUSPENSION FURNACES



FOR LAND AND MARINE BOILERS.

Uniform Thickness, Easily Cleaned, Unexcelled for Strength.

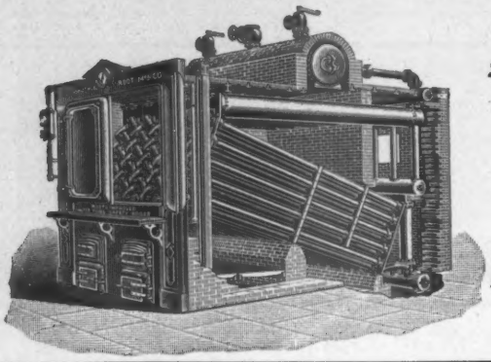
CORRUGATED FURNACES.

SOLE MANUFACTURERS IN THE UNITED STATES

THE CONTINENTAL IRON WORKS,

P. O. STA. G. BROOKLYN, N.

ROOT IMPROVED WATER TUBE BOILER



SELLING AGENTS:

Neave Building, Cincinnati, Ohio.
Security Building, St. Louis, Mo.
Monadnock Block, Chicago, Ills.

ABENDROTH & ROOT MFG. CO.,
28 Cliff Street,
NEW YORK.

Wanted

COPIES OF

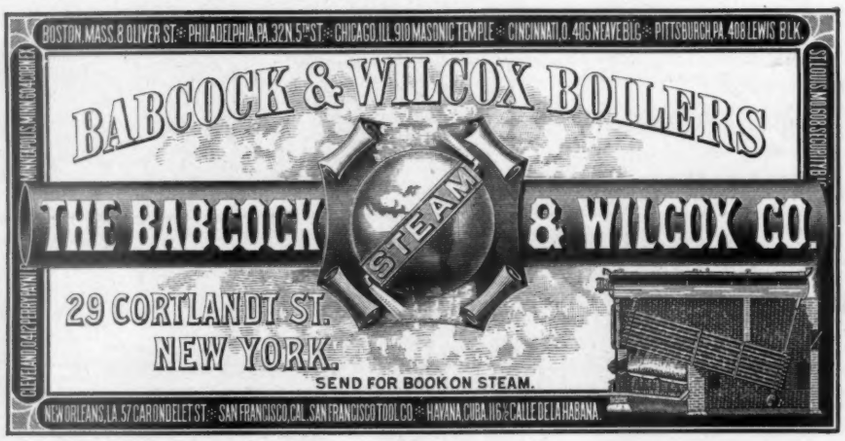
The RAILROAD and ENGINEERING JOURNAL

For June, 1888,
and September, 1890.

If in good condition, 50c. will be allow for the former and 25c. for the latter in exten subscriptions or cash.

ADDRESS:

M. N. FORNEY, 47 Cedar St.


BOSTON, MASS. 8 OLIVER ST. ✻ PHILADELPHIA, PA. 32 N. 5TH ST. ✻ CHICAGO, ILL. 910 MASONIC TEMPLE ✻ CINCINNATI, O. 405 NEAVE BLG. ✻ PITTSBURGH, PA. 408 LEWIS BLK.
BABCOCK & WILCOX BOILERS
THE BABCOCK & WILCOX CO.
STEAM
29 CORTLANDT ST.
NEW YORK.
SEND FOR BOOK ON STEAM.
NEW ORLEANS, LA. 57 CARONDELET ST. ✻ SAN FRANCISCO, CAL. SAN FRANCISCO TOOL CO. ✻ HAVANA, CUBA, 116 ✻ CALLE DE LA HABANA.

Compound Locomotives

ILLUSTRATED

BY

Prof. A. T. WOOD

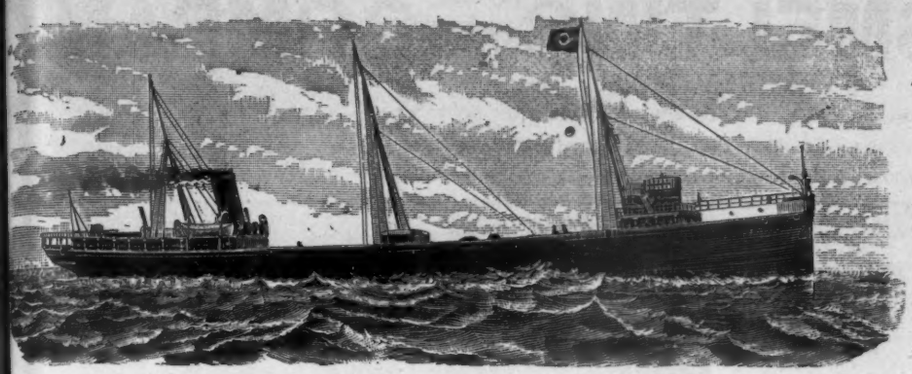
LATE OF
Washington University, St. Louis

No Master Mechanic of Progressive Tendencies can Afford to be Without it

The author describes the various forms of Compound Locomotives which have been actually used, and presents all the information necessary to guide those who have to desig type of engine. In addition to this highly useful information, a great deal of data and theories respecting Compound Locomotives are given. **2d Edition, $3.00.**

SPECIAL OFFER.—**$1.00** each for a few copies we have left of the First Edition.

Address M. N. FORNEY, 47 Cedar Street, New Y



THE CLEVELAND
SHIP-BUILDING COMPANY

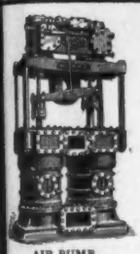
IRON SHIPS,

Marine and Staticnary Engines and Boilers

BLOWING ENGINES AND STEAM HAMMERS,

—Mill Gearing and Castings.—

Office on Viaduct, **Cleveland, Ohio.**



AIR PUMP,
Cruiser NEW YORK.

THE GEO. F. BLAKE MFG. CO.,

STEAM PUMPS

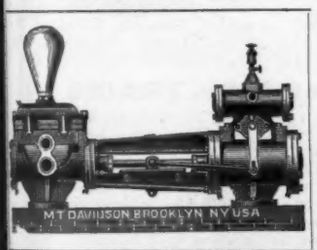
FOR MARINE SERVICE.

Single and Duplex, Vertical and Horizontal.

95 and 97 LIBERTY STREET,

NEW YORK.

DAVIDSON · STEAM · PUMPS



VERTICAL or HORIZONTAL.

AIR and CIRCULATING PUMPS.

ALSO CONDENSERS.

ASH EJECTORS.

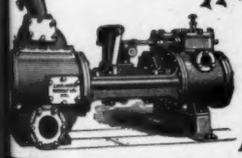
M. T. DAVIDSON,

43-53 KEAP ST., BROOKLYN, N. Y.

50 OLIVER ST., BOSTON. 133 LIBERTY ST., N. Y.

Dean Bros. Steam Pump Works,

INDIANAPOLIS, IND.



SINGLE & DUPLEX PUMPS.

HORIZONTAL AND VERTICAL PUMPS.

Best Design & Workmanship.

PRICES REDUCED Send for CATALOGUE.

CENTRIFUGAL PUMPS

An Essay on their Construction and Operation, and Some Account of the Origin and Development in this and other Countries.

By JOHN RICHARDS.

Twenty-Three Illustrations.

In Cloth Binding, postpaid, $1.00.

THIS BOOK consists of a series of practical notes, in which the author, who has had an extended experience in designing and constructing this class of machinery, gives the results of his observations and reflection. The principles and constructive features which must be conformed to in the design and construction of centrifugal pumps, in order to attain the greatest efficiency, are fully indicated. This is done in a series of concise and plain explanations which any practical man will recognize as a record of actual experience, and not the result of mere theoretical speculation. The book will be of great value to all who are engaged either in the construction, or who have, or expect to have, occasion to use such pumping machinery.

CONTENTS:

Section I.—Construction and Operation.
Section II.—History of Centrifugal Pumps.
Section III.—Appendix.

Sent by mail on receipt of price, which is $1.00.

Address

M. N. FORNEY,

47 Cedar St., New York.

WATER TUBE BOILERS.

Very interesting articles on this subject from both Foreign and American authorities, in the numbers from January of the

AMERICAN ENGINEER,

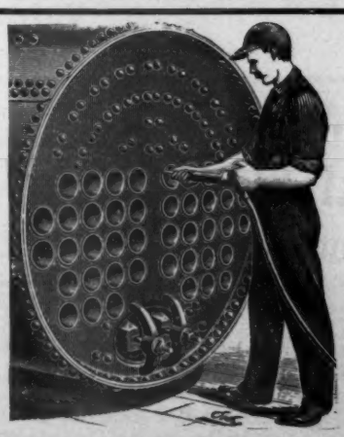
Now Issued Bi-weekly.

Single Copies, 10c.

Yearly Subscription, $2.50. Foreign Postage, $1.00 extra.

COMBINE SAFETY WATER TUBE BOILER

L. M. MOYES, MANUFACTURER, PHILADELPHIA, PA.



Pneumatic Tools

USED FOR

CALKING BOILERS,
BEADING FLUES,
HEADING RIVETS,
CHIPPING CASTINGS,
CUTTING KEY SLOTS,
DRIVING NAILS AND SPIKES.

Especially Adapted for Railroad Shops.

WILL BEAD TWO FLUES A MINUTE.

All Hammers sent on ten days' trial subject to approval and guaranteed for one year against repairs.

CHICAGO PNEUMATIC TOOL COMPANY

1553 Monadnock, Chicago.

CROWN ✦ SMELTING ✦ COMPANY,

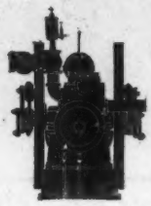
CHESTER, PA.

BRONZE, BRASS AND COMPOSITION METAL CASTINGS.

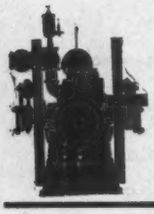
Inventors and Sole Manufacturers of **CROWN BRONZE**—an Improved Phosphorized Metal.

Manufacturers of PHOSPHOR-BRONZE to Pennsylvania Railroad Specifications, in either Ingot Metal, Locomotive or Car Bearings.

THE Air Pump on a Locomotive never was built for economy. It was built for simplicity—and it ISN'T economical



IF you think you are saving money by using an old one in the shop—just figure up your coal bills. You will find that you are not getting Compressed Air for nothing, even if you are utilizing part of the scrap heap



We are building

COMPOUND AIR COMPRESSORS WITH ADJUSTABLE STEAM CUT-OFF VALVES

They ARE economical. If you are using any quantity of Air, you will save money by buying one

Write us for Prices and Catalog

THE NORWALK IRON WORKS CO., - South Norwalk, Conn.

"Importance

OFT' ATTACHES TO TRIFLES LIGHT AS AIR.". . . . . .

Our Catalogue

No. 8

WILL TELL YOU WHY.

Clayton Air Compressor Works,

26 Cortlandt Street, New York.

JUST ISSUED

"Uses of Compressed Air."

BY

Addison C. Rand.

134 PAGES, 94 ILLUSTRATIONS, principally from original photographs and drawings.

This handy volume is the only comprehensive work upon the uses of compressed air. It is accurate, readably written and beautifully printed upon heavy plate paper.

Price, $1, postage paid.

M. N. FORNEY,
47 Cedar St.

FITCHBURG RAILROAD

Superb Equipment, Excellent Train Service, Fast Time, and Courteous Employes make the

HOOSAC TUNNEL ROUTE

THE FAVORITE LINE from Boston to Troy, Albany, Saratoga, Lake George, Adirondack and Catskill Mountains, Syracuse, Rochester, Buffalo, Niagara Falls, Hamilton, Toronto, Cleveland, Detroit, Cincinnati, Chicago, St. Louis, and all Points West, Southwest, and Northwest.

FAST EXPRESS TRAINS

With elegant PALACE PARLOR and SLEEPING CARS to and from

BOSTON AND CHICAGO—and—BOSTON AND ST. LOUIS

Via **NIAGARA FALLS,** without change.

ELEGANT PALACE PARLOR AND SLEEPING CARS to and from

BOSTON and MONTREAL, without change.

For Time-Tables, Parlor and Sleeping Car accommodations, or further information, apply to any Agent of the Fitchburg Railroad and at

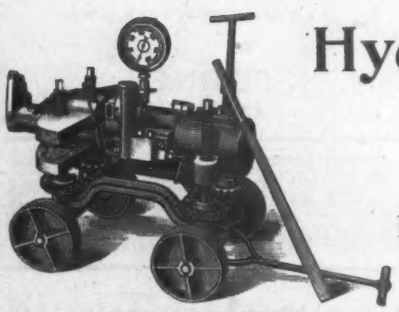
250 Washington St., or Fitchburg Railroad Pass. Station, Boston

J. R. WATSON, General Pass. Agent.

WATSON & STILLMAN.

204, 206, 208, 210 East 43d Street, New York.

HEADQUARTERS FOR ALL KINDS



CRANK PIN PRESS.

Hydraulic Tools for Railroads.

Improved Hydraulic Jacks,

FROM 4 TO 200 TONS.

Presses, Pumps, Accumulators,

Valves, Gauges, Fittings, etc.

Send for Catalogue K.

R. DUDGEON'S

Improved Hydraulic Jacks,

24 & 26 Columbia St., NEW YORK.

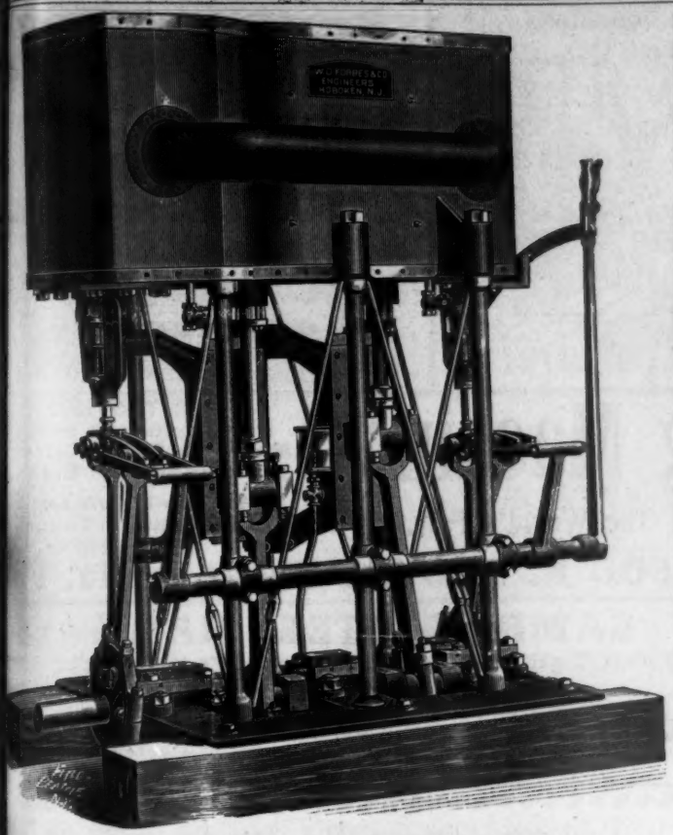
PATENTED 1884.

PUNCHES.

ROLLER TUBE EXPANDERS AND DIRECT-ACTING STEAM HAMMERS.

Jacks for Pressing on Car Wheels or Crank Pins.

Communications by letter will receive prompt attention.



Yacht and Electric Light Engines

SINGLE AND MULTIPLE CYLINDERS

W. D. FORBES & CO., 1305 Hudson St., HOBOKEN, N. J.

R. POOLE & SON CO.

ENGINEERS, FOUNDERS and MACHINISTS.

BALTIMORE, MD.

MANUFACTURERS AND DESIGNERS OF ALL KINDS OF

HEAVY MACHINERY,

REQUIRING FIRST CLASS WORKMANSHIP AND MATERIALS.

BAND, ROPE and FLY WHEELS, FRICTION CLUTCHES, SHAFTING, PULLEYS and HANGERS.

MACHINE MOLDED AND PLANED GEARING.

MACHINERY for WHITE LEAD and FERTILIZER WORKS, GRAIN ELEVATORS and FLOUR MILLS, BRASS, COPPER and TIN PLATE ROLLING MILLS, CABLE and MARINE RAILWAYS.

POOLE-LEFFEL TURBINE WATER WHEELS.

DREDGING MACHINES.

CIRCULARS on APPLICATION.

IRON CASTINGS of 30,000 LBS. TENSILE STRENGTH.

Bement, Miles & Co.,

PHILADELPHIA, PA.,

MANUFACTURERS OF

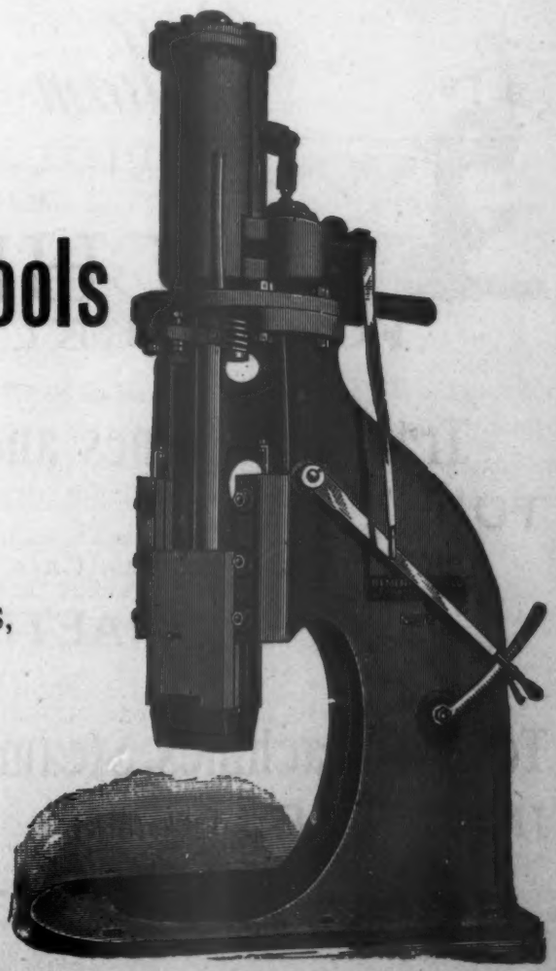
Metal-Working Machine Tools

— FOR —

Railroad Shops,
Locomotive and
Car Builders,
Machine Shops,
Rolling Mills,
Steam Forges,
Ship Yards,
Boiler Shops,
Bridge Works,
Etc., Etc.

Steam Hammers,

Steam and Hydraulic Riveting Machines.

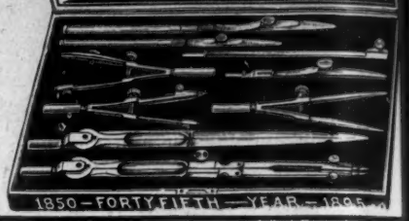


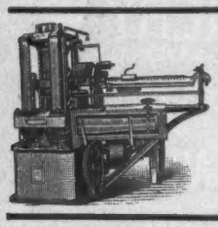
NEW YORK OFFICE:
Taylor Building, No. 39 Cortlandt St.

CHICAGO OFFICE:
1534 Marquette Building.

Two Hundred and Fifty Thousand Cars are equipped with the Dunham Doors
Perfect Fit - Lightly Moved - Steam Spark and Dust Proof
Qand C. Company Chicago.

T. ALTENEDER & SONS,
INSTRUMENT MAKERS,
PHILADELPHIA.
ALTENEDER DRAWING INSTRUMENTS.
HAVE YOU OUR LATEST (1895) CATALOGUE?





Olsen's Testing Machines.

Awarded Medal of Merit at The World's Fair.

FOR TESTING
Iron Specimens, Bridge Materials, Chain, Cement Wire Springs, Etc.

Hydraulic Presses, Accumulators, Gauges, and Pumps.

TINIUS OLSEN & CO., 500 N. 12th St., Philadelphia, Pa.

PITTSBURG TESTING LABORATORY, L't'd.

Geo. H. Clapp, Chairman. Alfred C. Hunt, Vice-Chairman&Treasurer.
116 WATER STREET, PITTSBURG, PA.

SPECIALTIES: Inspection of Rails and of Material for Bridges and other Structures, Steam Boilers, Locomotives, Cars, etc. Inspection of Shop Work and Erection at Bridge Site. Chemical Analysis and Physical Tests of all kinds.

Agents for Tinius Olsen & Co.'s Testing Machines: Thacher's Slide Rules.

CAMBRIA STEEL RAILS.

Heavy Rails, Light Rails and Rail Fastenings, Steel Car Axles, Steel Car Channels, Street Rails.

Address: CAMBRIA IRON CO.,

Office, 218 S. Fourth St., Phila., Pa. Chicago Office, Phenix Buildings.
[Works, Johnstown, Pa.]

New York Office for Rails and Fastenings, 33 Wall Street.

IMPROVED "STANDARD" COUPLER.

Manufactured by
STANDARD COUPLER CO.,
26 Cortlandt Street, NEW YORK.

GEO. A. POST, President,
A. P. DENNIS, Sec'y & Treas.

FORGED STEEL KNUCKLE AND LOCKING PIN.
Only Three Parts. No Pivot Pin.

SIMPLEST in DESIGN. STRONGEST in SERVICE.
Thousands in Use. M. C. B. Type.

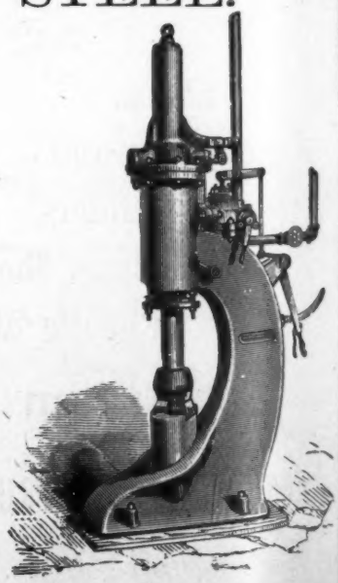
William Sellers & Co., Incorp.

PHILADELPHIA, PA.

MANUFACTURERS OF

MACHINE TOOLS

FOR WORKING IRON AND STEEL.



Traveling Cranes and Swing Cranes,

TURNTABLES,
for Locomotives, Cars, Etc.,

SHAFTING, Etc.,
for Transmission of Power,

Testing Machines, Steam Hammers, Etc., Etc.

INJECTORS,
for all Classes of Boilers.

AMERICAN ENGINEER AND RAILROAD JOURNAL

An Illustrated Publication

DEVOTED TO

Mechanical Engineering and Railroad Topics

Changed from a MONTHLY to a BI-WEEKLY

Price reduced from 25c to 10c

YEARLY SUBSCRIPTION, $2.50 **FOREIGN POSTAGE, $1.00 EXTRA**

The objects aimed at in making this change are first, to bring the paper within the range of expenditure of a larger class of readers; second, to keep it nearer abreast of current events and make it more of a newspaper than heretofore; and third, without lowering its standard or lessening its value to engineers, we will endeavor to make it more acceptable to practical mechanics.

Some other changes and improvements are contemplated and will be made during the coming year. *Our specialty of railroad engineering* will in the future include the *electrical field*, which is extending so rapidly. *Naval matters* will continue to receive special attention and it will be our purpose to make the department of marine engineering of greater value than ever. In *railroad engineering*, the construction of *locomotives*, *cars*, *shop-tools*, and *appliances*, *signals*, *track construction* and *bridges* will be included.

The design, construction and operation of *steam engines* and *boilers* of all kinds will constantly be presented to our readers, and we will hope to give them the latest information which is accessible. No paper has discussed the relative merits of *fire and water-tube boilers* as fully as they have been presented in our pages, and we will continue to give both sides of this and other questions which are our specialties.

With reference to the "Labor Question" we will hereafter, as heretofore, use the influence of the paper for the promotion and maintenance of industrial peace, and not war, and will do all in our power to induce employers and employed to adopt measures which will lead to the settlement of disputes by methods of conciliation, arbitration and compromise, and not by strikes.

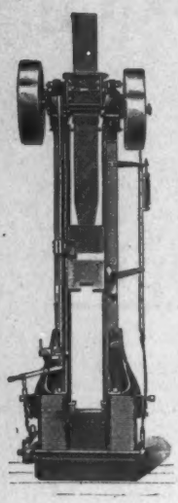
During this year from forty to fifty engravings were published each month. As many or more illustrations will be given in the future as in the past.

Your subscription is solicited

Order direct or through your newsdealer

M. N. FORNEY, Editor & Prop'r

47 Cedar Street NEW YORK



DROP HAMMERS.

SIMPLE,
DURABLE,
EFFICIENT.

The HAMMER is made of FORGED WROUGHT IRON.

The UPRIGHTS are made of Wrought Steel.

An Automatic Trip Adjustment is provided on all the drops as well as the lever. One may be substituted for the other.

Merrill Brothers,
Kent Ave. & So. 11th St.
BROOKLYN, N. Y.

Bell's Improved Steam Hammer.

45 in Use in Buffalo Alone.

4 Different Sizes.

	Diam. Cylinder.	Stroke or Lift.
No. 1	6 in.	16 in.
No. 2	8 in.	18 in.
No. 3	10 in.	22 in.
No. 4	12 in.	27 in.

	Strikes Blow.
No. 1,	2,000 lbs.
No. 2,	4,000 lbs.
No. 3,	6,000 lbs.
No. 4,	10,000 lbs.

Illustrated Catalogue and Prices sent on application.

BELL'S ENGINE WORKS,
BUFFALO, N. Y.
ESTABLISHED 1845.

L. GOES'

Genuine Improved Knife-Handle Patent

Screw Wrenches

MANUFACTURED BY
COES WRENCH CO., Worcester, Mass.
ESTABLISHED 1839.

Patented July 6, 1880, and July 8, 1884.

Sectional view illustrates our New Knife Handle, showing malleable iron frame and shank of bar keyed into position.

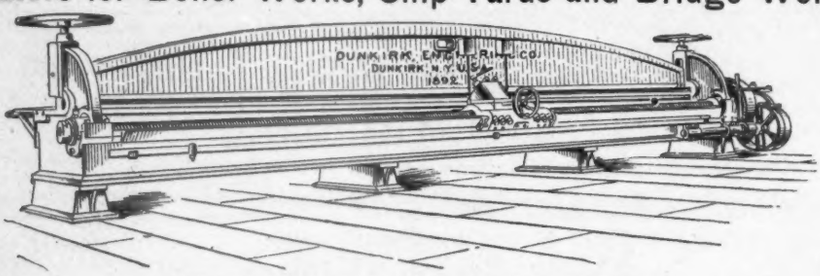
☞ Straight Bar, Extra Long Nut, for Screw in Jaw.

The Best Made and Strongest Wrench in the Market.

J. C. McCarty & Co.
John H. Graham & Co. } Agts.
NEW YORK.

Dunkirk Engineering Company.

Planers for Boiler Works, Ship Yards and Bridge Works.



Geared Locomotives a Specialty.

DUNKIRK NEW YORK.

THE DICKERMAN EMERY WHEEL AND MACHINE CO.

BRIDGEPORT, CONN.

MANUFACTURERS OF

Grinding and Polishing Machinery

Send for Catalogue

Carries 4-10" or 2-12" Emery Wheels

ASBESTOS ROPE AND WICK PACKINGS,

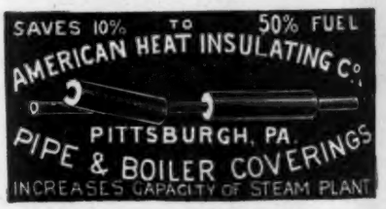
Felts, Mill Boards, and Fibres,
Sectional Pipe and Boiler Coverings,

ASBESTOS ROOFINGS.

ALL KINDS OF **BUILDING AND ROOFING PAPERS.**

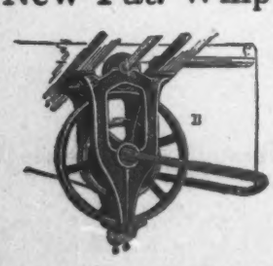
H. F. WATSON COMPANY, Erie, Pa.

CHICAGO. NEW YORK. NASHVILLE, TENN.



MINERAL WOOL,
ASBESTOS GOODS,
INSULATING MATERIALS
OF ALL KINDS.

New Pat. Whip Hoist.



A Single Lever Hoists, Lowers and Holds the Load.

VOLNEY W. MASON & CO., Providence, R. I.

New Patent Balanced Segment FRICTION PULLEY.

Bridgeport Safety Emery Wheel Co.,

BRIDGEPORT, CONN.,

PATENTEES AND MANUFACTURERS OF

Safety Emery Wheels AND Appliances,

EMERY WHEEL MACHINERY AND SUPPLIES.

TIPPETT & WOOD,

PHILLIPSBURG, N. J.

Roof Trusses and Girder Work.

TURNTABLES, STEAM BOILERS, STAND PIPES.

GENERAL CONTRACTORS IN IRON AND STEEL PLATE WORK.

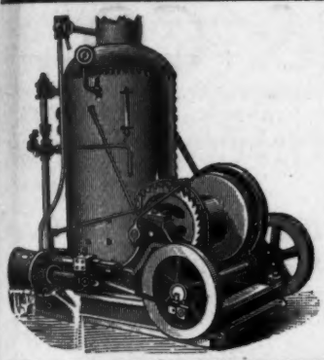
L. E. COCHRAN, *President.*
B. F. BOYD, *Sec'y and Treas.*

J. P. KENNEDY, *Vice-President and Gen'l Manager.*
C. E. FOWLER, *Chief Engineer.*

THE YOUNGSTOWN BRIDGE CO.,

YOUNGSTOWN, OHIO.

RAILROAD WORK A SPECIALTY.



THE CONTRACTORS' PLANT MFG. CO.

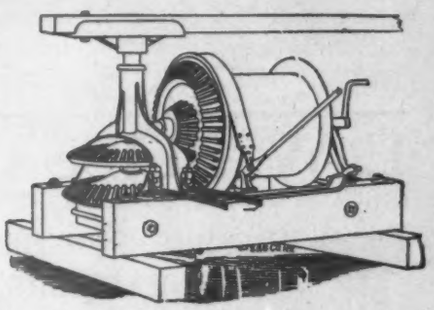
MANUFACTURERS OF

Steam, Horse and Hand Power

Hoisting Machines,

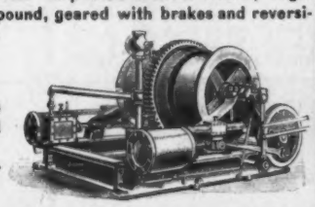
DERRICK IRONS AND CONTRACTORS' SUPPLIES.

129 Erie Street, *Buffalo, N. Y.*



HOISTING MACHINERY

For Mining, Quarrying, Coal Handling, Pile Driving, Bridge Building, Log Hauling, and for General Contractors' Use. Improved Electric Hoists, single and double Patent Friction Drum, compound, geared with brakes and reversible, for general Hoisting, Mining Purposes, and Suspension Cableways.



Send for **ILLUSTRATED CATALOGUE** giving full description, etc.

Correspondence solicited.

W. A. CROOK & BROS. CO., Newark, N. J.

Salesrooms: 143 Liberty St., N. Y.

NO. 1.

H. J. McKEOWN

MANUFACTURER OF

Contractors' Plant, Stone Hoisting and Pile Driving Engines.

CRABS DERRICK IRONS A Specialty

The Record and Price of this Hoisting Engine need only to be investigated to commend it to every user.

196 E. FRONT STREET,
CINCINNATI, O.

Correspondence solicited.

Emery and Corundum Wheels

FOR ALL PURPOSES.

We make four different processes. Guaranteed to give satisfaction. Write for catalogue.

The Springfield Manufacturing Co.,

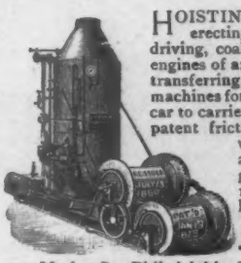
BRIDGEPORT, CONN.

Chicago Branch: 125 SO. CLINTON ST., Chicago, Ill.

HOISTING ENGINES

MANUF'D BY THE JOHN F. BYERS MACHINE CO., RAVENNA, OHIO

WRITE FOR CATALOGUE.

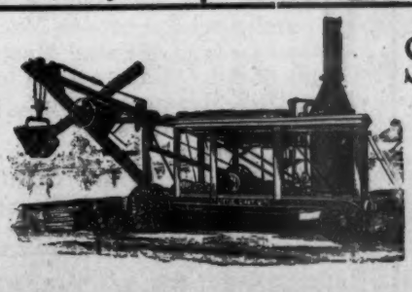


HOISTING, mining, bridge erecting, dock building, pile driving, coal hoisting and quarry engines of any power, sugar cane transferring engines, transferring machines for depositing cane from car to carrier, with my improved patent friction drums, with or without boilers. Any amount of reference given. Established in 1870. Send for Catalogue.

J. S. MUNDY,

NEWARK, N. J.

1744 Market St., Philadelphia, Pa.
22 Light St., Baltimore, Md.
117 Water St., Pittsburg, Pa.
249 South Jefferson St., Chicago, Ill.
75 North Second St., St. Louis, Mo.
39 Magazine St., New Orleans, La.
34 Fremont St., San Francisco, Cal.
53 Front St., Portland, Ore.
Fourth & Wakouta Sts., St. Paul, Minn.
218 Congress St., Boston, Mass.

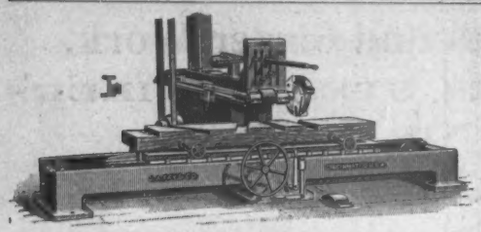


STEAM SHOVELS

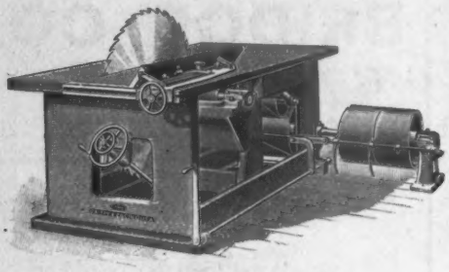
SEND FOR CATALOGUE.

THE VULCAN IRON WORKS CO.,

TOLEDO, OHIO, U. S. A.



No. 3.—Extra Large Patent Automatic Car Gaining Machine.



No. 4.—Large Car Ripping Saw.

WOOD WORKING MACHINERY

. . FOR . .

CAR AND LOCOMOTIVE BUILDERS

A SPECIALTY.

PLANS, SPECIFICATIONS AND ESTIMATES ON APPLICATION.

J. A. FAY & CO.,

506 to 526 West Front St., CINCINNATI, O.

E. W. BLISS CO.,

18 PEARL STREET, BROOKLYN, N. Y.

CHICAGO OFFICE: 96 W. WASHINGTON ST.

PRESSES, PUNCHES,
DROP-HAMMERS,
SHEARS, DIES,
FRICTION CLUTCHES
AND
SPECIAL MACHINES.

THE STILES & PARKER PRESS CO.

Frank P. Cady, Pres. and Supt. Geo. H. Bowler, Secy. and Treas.

The Cady M'f'g Co.,

18-20-22 Johnson St., CLEVELAND, O.

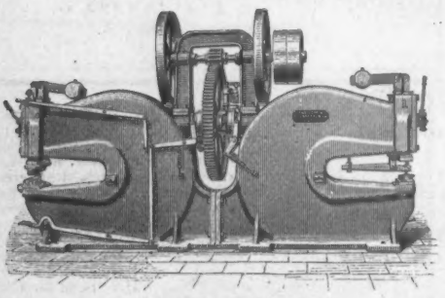
POWER PRESSES,
DROP HAMMERS

AUTOMATIC
WIRE FORMING MACHINERY.

DIES,
SPECIAL MACHINERY.

THE LONG & ALLSTATTER CO.

HAMILTON, OHIO.



Heavy Double Machine.

GENERAL PURPOSE,
BOILER, HORIZONTAL,
MULTIPLE, AUTOMATIC
AND
HAND SPACING and SPECIAL

Punching Machinery,

AND SHEARS FOR CUTTING PLATES, BARS AND ANGLE IRON OF ALL SIZES.

BOUND VOLUMES

FOR

1887,
1888,
1889,
1890,
1891,
1892
1893
and
1894.

Price, $4.50 each.

Subscribers can have their files bound for $1.25 per volume.

Address

M. N. FORNEY,
47 Cedar Street, New York.

GOULD & EBERHARDT, Newark, N. J.

"Double, Triple Quick Stroke" SHAPER.

12", 16", 20", 24", 26", 30"

Capable of giving from 50 to 100% more strokes per minute over any other make on the market.

Send for circular.

The Pratt & Whitney Co.,

HARTFORD, CONN., U. S. A.,

DESIGN and Manufacture Machine Tools for general and special service in Machine, Railway, Electrical Apparatus, Gun, Sewing Machine and Brass Plumbers' Goods Shops. Make a great variety of styles and sizes Taps, Dies, Reamers, Gauges, Milling Cutters. Holders with inserted cutters for use in lathes and planers for turning, forming, cutting off, threading, etc.; also Renshaw's Ratchet Drills, Combination Lathe Chucks, Kennedy's Patent Spiral Shear Punch; Improved Automatic Grain Scale, etc.

SEND FOR "F" CATALOGUE.

KEUFFEL & ESSER CO.
NEW YORK.
BRANCHES: 111 Madison Street, Chicago. 708 Locust Street, St. Louis.
MANUFACTURERS AND IMPORTERS OF
Drawing • Materials
AND
SURVEYING INSTRUMENTS.
Catalogue on Application.

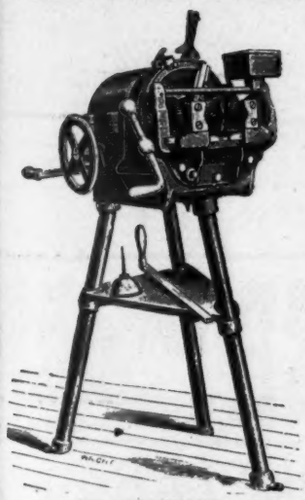
WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap & Machine Screws, Studs, etc.

HARVEY HUBBELL,
Machinery and Tool Mfr.
Improved Tapping Machines.
SCREWS
Machine Screws for electrical purposes. Sample box free.
BRIDGEPORT, CONN.

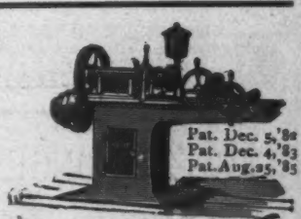
Fine Machine-Relieved Taps,
Tap Wrenches, Screw
Plates, Reamers, Bolt Cutters,
Drilling Machines, Etc.
SEND FOR CATALOGUE
LIGHTNING.
[Trade Mark]

GREEN RIVER.
[Trade Mark]
WILEY & RUSSELL MFG. CO.
Greenfield, Mass., U. S. A.

THE ARMSTRONG MANUFACTURING CO.

No. 1 MACHINE.
BRIDGEPORT, CONN.
Manufacture High Grade Tools Celebrated for their Time and Labor Saving Qualities.
PIPE THREADING AND CUTTING-OFF MACHINES, STOCKS AND DIES AND OTHER TOOLS FOR
WATER, STEAM & GAS FITTERS.
Bolt Dies, Lathe Dogs, Pipe Vises, etc., etc.
A Postal will bring our Catalogue.
NEW YORK OFFICE: 139 CENTRE STREET.

BINDERS!
To anyone remitting 50 cents, a flexible binder for this Journal will be forwarded by mail, post-paid.

HOWARD IRON WORKS,
BUFFALO, N. Y.
MANUFACTURERS OF
SCHLENKERS' AUTOMATIC BOLT CUTTERS.

THE ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of
ACME BOLT & RIVET HEADERS
Acme Single & Double Automatic Bolt Cutters.
Cutting from ⅜ in. to 6 in. diam.
Also, SEPARATE HEADS and DIES.


Stow Flexible Shaft.
Invented and Manufactured by the
STOW MANUFACTURING COMPANY,
Established in 1875. BINGHAMTON, N. Y.
For Tapping and Reaming Stay Bolt Holes in
BOILERS.
Portable Drilling.

BIG FOUR ROUTE.
Cleveland, Cincinnati, Chicago & St. Louis Railway
TO
Western and Southern Points
Through Sleeping Cars from
New York to Cincinnati, Indianapolis and St. Louis
VIA
New York Central to Buffalo, L. S. & M. S. Ry. to Cleveland, Big Four Route to Destination.
ELEGANT CONNECTIONS
With all Trunk Lines in New York State.
Ask for Tickets via BIG FOUR ROUTE.
E. O. McCORMICK, Passenger Traffic Manager.
D. B. MARTIN, Gen'l Pass. & Tkt. Agt.
BIG FOUR ROUTE, CINCINNATI, O.

STEEL AND WROUGHT IRON CASTINGS.
The strongest Castings made, turned out in from 3 to 5 days after receipt of patterns.
J. A. & P. E. DUTCHER CO., MILWAUKEE, WISCONSIN.

THE JANNEY FREIGHT CAR COUPLER

THE McCONWAY & TORLEY COMPANY

W. McC CONWAY—PRESIDENT.

48th ST. & A.V.RY.—PITTSBURGH, PA.

Strictly M. C. B. Lines.

See Official Railway List for 1892.

JOHNSTON COUPLER

Johnston Car Coupler Company.
204 Walnut Place,
Philadelphia, Pa.

THE COUP AUTOMATIC CAR COUPLER.

NOTICE is hereby given to all persons, firms or corporations now engaged in making, selling or using an automatic car coupler of any standard or type having a flexible head with a lateral or vertical movement are infringing upon the patents granted to John Coup and now controlled by me, and such infringements will be resisted to the full extent of the law. And by this notice I do not intend to waive or abridge any or all rights granted and covered by said patents.

CHARLES D. GIBBONS, Sole Lessee, 202 Society for Savings, CLEVELAND, O.

THE STRONGEST PIPE AND NUT WRENCH

This Wrench has become a general favorite among Plumbers, Steam Fitters and Jobbers generally. Every one sold helps to sell others. SEND FOR CIRCULAR AND PRICES.

WRIGHT WRENCH CO., Worcester, Mass.

SOUTH BROOKLYN

RUST PROOF IRON AND STEEL WORKS.

GESNER PROCESS.

Latest, most perfect, and cheapest, converting body of surfaces treated into a Double Carbide of Iron and Hydrogen. Does not scale. Does not alter dimensions. Architectural Iron, Art Hardware, etc., treated. For prices, also for shop rights for iron and steel, apply to

G. W. GESNER, 15 State St., New York.

STEEL CASTINGS

FROM 1 TO 40,000 POUNDS WEIGHT

—Of Open Hearth, Chester or Bessemer Steel.—

TRUE TO PATTERN. SOUND. SOLID.

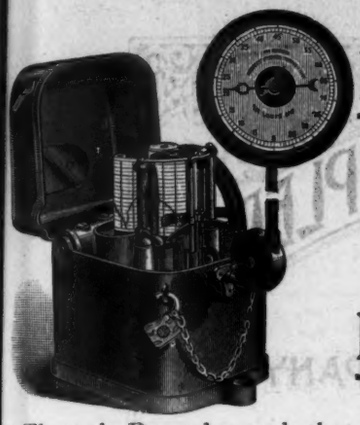
GEARING OF ALL KINDS, CRANK SHAFTS, KNUCKLES FOR CAR COUPLERS

Cross-Heads, Rockers, Piston Heads, etc., for Locomotives. STEEL CASTINGS OF EVERY DESCRIPTION.

CHESTER STEEL CASTINGS CO.,

Works: Chester, Pa. *Office: 407 Library St., Philadelphia, Pa.*

THE BOYER



Railway Speed Recorder.

The only Recorder made that gives a chart of the run that can be read at sight, and has a DIAL INDICATOR carried into the CAB so Engineer can see at a glance, any time, what speed he is running.

BOYER RAILWAY SPEED RECORDER CO.,
244 DICKSON STREET,
ST. LOUIS, MO., U. S. A.

OFFICES
66 Broadway NEW YORK
941 The Rookery CHICAGO
319 Commercial Bldg ST. LOUIS

GOULD COUPLER CO.

WORKS
Steam Forge BUFFALO, N. Y.
Malleable Iron DEPEW, N. Y.
Cast Steel ANDERSON, IND.

PILOT COUPLER

LATROBE STEEL WORKS,

MANUFACTURERS OF

TIRES

FOR LOCOMOTIVE AND CAR WHEELS.

Works and Main Office, LATROBE, Pa. Branch Office, BULLIT BUILDING, Philadelphia.

Chicago Office, Western Union Building. New York Office, Home Insurance Building.
St. Louis Office, Union Trust Building.

SUPERIOR Graphite Paint

For BRIDGES, ROOFS, STRUCTURAL IRON, and all Exposed Metal or Wood Surfaces.

Warranted not affected by heat, cold, salt brine, acid fumes, smoke or chemicals.

Detroit Graphite Mfg. Co., DETROIT, MICH.

THIRD THOUSAND

Kent's Mechanical Engineer's Pocket Book

1060 pages, 12mo, morocco, $5.00

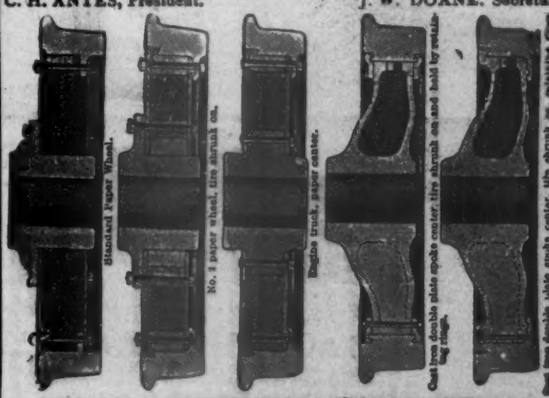
"A good work well done."—R. H. THURSTON

Sent on receipt of the price. Address

M. N. FORNEY
47 Cedar Street, New York

ALLEN PAPER CAR WHEEL CO.

General Office, CHICAGO, ILL.
Works: Hudson, N. Y. NEW YORK Office, 31 and 33 Broadway. Works: Pullman, Ill.
C. H. ANTES, President. J. W. DOANE, Secretary.



STEEL-TIRED WHEELS.
FOR CAR, LOCOMOTIVE AND TENDER TRUCKS.

RAILWAY CAR CONSTRUCTION,

By WILLIAM VOSS.

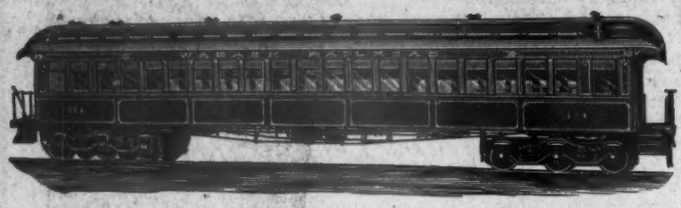
The ONLY WORK of the kind published.

Illustrated with upwards of 500 Working Drawings, showing complete cars and details. Price, $3.00. Sent on receipt of price.

M. N. FORNEY, 47 Cedar Street.

PASSENGER CARS of the finest finish, as well as every description of CAR WORK furnished at short notice and at reasonable prices by the

HARLAN & HOLLINGSWORTH CO., WILMINGTON, DEL.



ST. CHARLES CAR CO.,

ST. CHARLES, MO.

W. H. GLASGOW, President.
H. B. DENKER, Vice-Pres. and Gen'l Manager. RALPH AYMOND, Sec'y and Treas.

MANUFACTURERS OF

Box Cars, Stock Cars, Ore Cars, Coal Cars, Flat Cars, Logging Cars, Warehouse Trucks, Refrigerator, Excursion and Caboose Cars, Hand, Push and Mining Cars, Castings and Forgings.

WASON MANUFACTURING COMPANY,

SPRINGFIELD, MASS.

ESTABLISHED 1845. NEW SHOPS CONSTRUCTED IN 1872.

BUILDERS OF

Passenger, Parlor, Dining and Excursion Coaches, Baggage and Mail Cars; Refrigerator, Stock and Freight Cars of every description. Crank or Lever Hand Cars and Push Cars.

P. O. Address: BRIGHTWOOD, MASS. *Cable Address: WASON SPRINGFIELD*

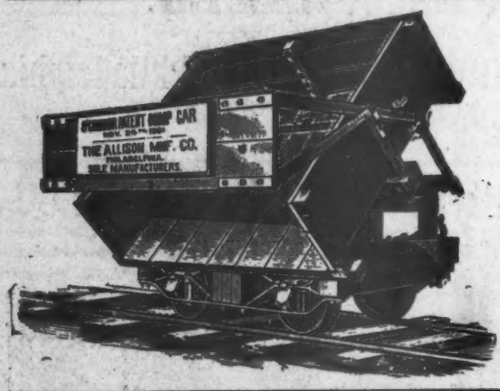
GEO. C. FISK, Prest. H. S. HYDE, Treas. H. PEARSON, Supt.

THE YOUNGSTOWN CAR MAN'F'G CO.,

RAILROAD FREIGHT CARS.

Youngstown, Ohio.

L. E. COCHRAN, Prest.
B. F. BOYD, Sec'y and Treas.
ANDREW MILLIKEN, Gen. Man.



THE ALLISON MFG. CO., PHILADELPHIA, PA.,

MANUFACTURERS OF

FREIGHT CARS OF EVERY DESCRIPTION.

ALSO, SOLE MANUFACTURERS OF

O'CONNOR'S PATENT DUMP CAR,

THE MOST SERVICEABLE CAR IN THE MARKET FOR RAILROADS, CONTRACTORS and OPERATORS OF STEAM SHOVELS.

Illustrated Circular of this Dump Car sent on application.

RAILROAD ENGINEERING

Bridge, Hydraulic, Municipal, Civil, etc. Electricity, Architectural and Mechanical Drawing, Mining, Plumbing, English Branches, etc.

TAUGHT BY MAIL.

Twenty-seven courses of study. Reference and testimonials furnished. Send for free circular. State subject you wish to study.

The International Correspondence Schools, SCRANTON, PA.

MAXON PAT. JACKS,

LEVER and SCREW

Unequalled for all varieties of

RAILROAD USE.

OUR

DROP TRACK JACK

beats anything in its line.

MANUFACTURED BY

THE McSHERRY MFG. CO.,

Grand Ave., Middleton, O.

Catechism of the Locomotive.

(REVISED EDITION.)

M. N. FORNEY 47 Cedar St., N. Y.

This book is intended for a large class of readers, among whom are all kinds of railroad officers and employees, consisting of locomotive engineers, firemen, and the many different kinds of mechanics employed in railroad shops and in the construction of locomotives and other railroad machinery and material. It has therefore been written in as simple and plain language as the writer could command, and the subjects presented are explained with the least possible employment of either scientific or practical technicalities.—**PRICE, $3.50.**

Publications of the American Engineer.

The following books and reference cards have been published by the AMERICAN ENGINEER and may be obtained by addressing M. N. Forney, 47 Cedar Street, New York, or of Messrs. Sampson Low, Marston & Co., Limited, St. Dunstan's House, Fetter Lane, E. C., LONDON, W. H. Kühl, 73 Jäger Street, BERLIN, or Baudry & Co., 15 Rue des Saints-Pères, PARIS.

Proceedings of the Conference —ON— AËRIAL NAVIGATION,

HELD IN

CHICAGO, AUGUST 1, 2, 3 AND 4, 1893.

429 pages, 5¾ x 9 in.

Sent by mail on receipt of price, which is $2.50.

An International Conference on Aërial Navigation formed one of the series of "Congresses" which were held in Chicago during the summer of 1893, when the Columbian International Exhibition was opened. The meetings of this Conference proved to be successful and interesting beyond expectation. The efforts of the committee in charge of them to secure the co-operation of scientific men and capable engineers, and reports of experimental investigations, facts and positive knowledge rather than speculations or descriptions of projects was abundantly rewarded. Some thirty-five papers were contributed, covering many of the problems of Aëronautics and Aviation, and presenting the observations and results of experiments of experts who are eminent as scientific men or experienced engineers, or both. The subject was taken out of the hands of "cranks," and was discussed by those who, by reason of their knowledge and training, were competent to do so. These papers and the discussions thereon, all of which are of very great interest to those who have any concern in the fascinating subject of Aërostation, have been published in a volume of over 400 pages.

PROGRESS IN FLYING MACHINES.

By O. CHANUTE, C. E.

308 pages, 5¾ x 8½ in.

Sent by mail on receipt of price, which is $2.50.

This book gives an historical review of the efforts and experiments of inventors to accomplish flight with apparatus, which by reason of its rapid movement will be supported by the air as birds are. The author has gathered all the records of such experiments which were accessible, and has endeavored to show the reasons for their failure and to explain the principles which govern flight, and to satisfy himself and his readers, whether we may reasonably hope eventually to fly through the air. His conclusion is that this question may now be answered in the affirmative. A full account is given of the recent experiments of scientists like Maxim, Lilienthal, Hargraves and Langley. The book contains over 300 pagillustes and is rated by nearly 100 engravings.

Mr Chanute has brought together in this volume about all that is worth saying on the subject of aerostation. He sketches the intelligent attempts that have been made, gives their records, theory of work and probable causes of failure. He shows what the scientfic principles of flight are, and after discussing the difficulties which surround the subject, the progress which has been made and the difficulties which remain unsolved, he adheres to his conviction that real progress has been made, and that the problem will ultimately be solved. —*Independent.*

AMERICAN ENGINEER'S REFERENCE CARDS.

Some months ago the first of a series of **Reference Cards** was issued by the AMERICAN ENGINEER AND RAILROAD JOURNAL. These contain data to which engineers, mechanics, draftsmen and others have frequent occasion to refer. They are printed on strong manilla cards (5 x 7 in.) which will bear much handling. Thus far six of these cards have been published, as follows:

No. 1. *Proportions for Sellers' U. S. or Franklin Institute Screw Threads, Nuts and Bolt Heads.*

No. 2. *Symbolical Shading and Colors for Drawings of Cross-sections of Different Materials.*

No. 3. *Standard Dimensions, Heating-Surface, etc., of Lap Welded Iron Boiler Tubes.*

No. 4. *Weights, Evaporative Powers per Weight and Bulk, etc., of Coals.*

No. 5. *Standard Form and Proportions for the Treads and Flanges of Car Wheels, the Gauge of Wheels, Frogs, etc.*

The last card which has been published is No. 6, which contains Instructions to Boiler Attendants, as Issued by the Manchester Steam Users' Association. (Double No.).

It is thought that all persons, firms or companies using boilers, and who must of necessity incur the responsibility which such use implies, should place a copy of these rules in the hands of the person or persons who have the care of their boilers. Engineers and firemen who to a very great extent are responsible for the safety and economical management of boilers will find no better guide in the performance of their duties, than is embodied in these rules which have been prepared by the above Association. They should be placed in every boiler room.

Copies of any of the above cards may be obtained by sending a two cent postage stamp for each one to the publisher of the **American Engineer and Railroad Journal.**

They are issued for the convenience of those who frequently have occasion to make use of the data they contain. The collateral purpose which the cards are intended to serve —that of making the **American Engineer and Railroad Journal** and its contents known to a class of persons for whom it is intended—will not, it is thought, lessen the usefulness or convenience of the tables in the form in which they are printed.

Orders should be sent to **M. N. FORNEY**, Editor and Proprietor of the American Engineer and Railroad Journal, 47 Cedar Street, New York.

ANY BOOKS RELATING TO MECHANICAL ENGINEERING OR INFORMATION WITH REFERENCE THERETO, MAY ALWAYS BE OBTAINED BY ADDRESSING—

M. N. FORNEY, 47 Cedar Street, New York.

— 1895 —

Bound Volumes

American Engineer and Railroad Journal

Ready for Delivery

Dec. 20th.

PRICE, Post Paid, . . $4.50

MODERN METHODS

APPLIED TO ELEVATING AND CONVEYING MATERIALS AND TRANSMITTING POWER.

Machinery designed and erected to suit existing conditions and available space.

Ewart Link-Belt, Monobar, Dodge, Ley,

And other improved Chains with all approved appliances and devices for complete equipments and efficient work.

LINK-BELT ENGINEERING CO.,

Nicetown, Philadelphia. 49 Dey St., New York.

Chicago:—LINK-BELT MACHINERY CO.

The Sterling Emery Wheel Mfg. Co.,

TIFFIN, O.

MANUFACTURERS OF

Emery and Corundum Wheels.

EASTERN AGENTS:

L. BEST 45 Vesey Street, New York. CUTTER, WOOD & STEVENS, 131 Pearl Street, Boston.

SCARRITT FORNEY CAR SEATS CHAIRS

50 PATTERNS

RECLINING
PARLOR
SMOKING

CAR SEATS, AND CHAIRS

MANUFACTURED IN ALL-WOODS TO MATCH CAR FINISH AND IN ALL COLORS, COVERED IN PLUSH, LEATHER OR RATTAN.

Our Seats and Chairs in use by nearly 200 U. S. Railways, and in 10 Foreign Nations.

5 POINTS OF SUPERIORITY: COMFORT, SIMPLICITY, DURABILITY, ELEGANCE, ECONOMY

THEY ARE KNOWN THE WORLD OVER.

SCARRITT FURNITURE CO.,

For information, address ST. LOUIS OFFICES: 1520, 1522, 1524, 1526 N. 13th St., 412-414 N. 4th St., 612, 614, 616 N. 2d St.

WAREHOUSES: 314 Vine St., 805 N. 2d St.

NEW YORK: 16 Warren St., where seats may be seen at the store of the Peerless Rubber Co. (Ground Floor).

St. Louis, Mo., U. S. A.

SANFORD MILLS — CAR PLUSHES

ARE THE BEST

FOR

DURABILITY OF FABRIC

AND

FASTNESS OF COLOR : :

L. C. CHASE & CO.,

SELLING AGENTS,

338 Broadway, New York. ◆ 260 Fifth Ave., Chicago, Ill.

199 Washington Street, Boston, Mass.

"RESTAURO"

Has no equal for Cleansing and Restoring Plush to its Original Color without removing it from the seats. Send for sample.

RESTAURO MANUFACTURING CO.,

39-41 Cortlandt Street, NEW YORK.

THE ROBERT AITCHISON PERFORATED METAL CO. CHICAGO, ILL.

PERFORATED METALS FOR All Railroad Purposes.

The Safety Car Heating and Lighting Co.,

Heating Systems.

By hot water circulation and direct steam with regulating devices.

Reliable and Uniform Heat.

Economical and Rapid Circulation.

Gibbs' Automatic Coupler of Westinghouse type, absolutely steam-tight

Lighting System.

The Celebrated **Pintsch** Compressed Oil Gas method.

In use on over 55,000 cars in Europe and America.

Adopted by the U. S. Lighthouse Board for lighting Buoys.

The best, most economical, and only safe light for railroad purposes.

In brilliancy and cleanliness unsurpassed.

◆——OFFICE: 160 BROADWAY, NEW YORK.——◆

A. W. SOPER, President. ROBERT ANDREWS, Vice-Pres. W. R. THOMAS, Treas. C. H. HOWARD, Sec'y. R. M. DIXON, Eng.

PRESSED STEEL TRUCK FRAMES

And Pressed Steel Parts for Car and Truck Construction.

FOX SOLID PRESSED STEEL COMPANY { GENERAL OFFICES: Western Union Bldg., Chicago. WORKS: Joliet, Illinois.

JAMES B. BRADY, General Sales Agent, Havemeyer Building, New York.

REVISED

POCKET GEOLOGIST

AND

MINERALOGIST,

OR

Sixteen Practical Chapters,

By FREDERICK H. SMITH, Engineer and Geologist.

212 pages. Cloth bound. Pocket and Flap. Price, $1.00.

Sent by mail, on receipt of price, by

M. N. FORNEY, 47 Cedar St., N. Y.

The Hot-Water Baker Car Heater

The Fire-Proof Baker Car Heater

AND SIX OTHER STYLES

10,000 in Use during the Last Eight Years

Every First-class Car has it where Safety, Compactness and Comfort are considered. Northern Pacific has 116, Philadelphia and Reading has 70, Minn., St. P. and Sault Ste. Marie has 43, Canadian Pacific has 32, Illinois Central, 35, Chicago, Milwaukee & St. Paul, 8, Pennsylvania Railroad, 9. Also in private cars of the Goulds, President Roberts of the Pennsylvania Railroad, and many other Railroad Magnates.

WILLIAM C. BAKER

Successor to THE BAKER HEATER CO.

Central Building, 143 Liberty St., New York

Beware of Imitations Inventor and Sole Manufacturer of all Improvements

---

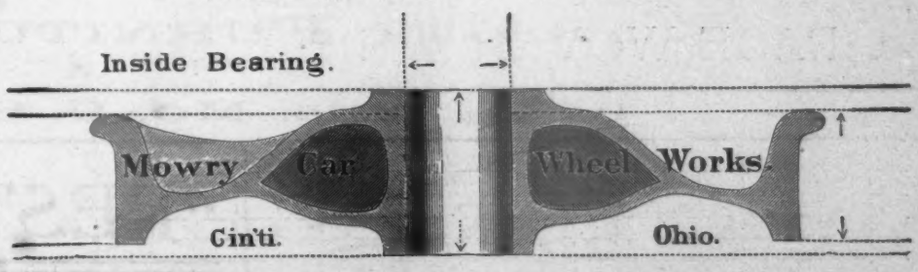
The Lake Shore & Michigan Southern Railway.

IT LEADS

In Completeness of Equipment,
Comfort of Transport,
Promptness of Service,
Fast and Elegant Trains.

A. J. SMITH, G. P. & T. A.,

CLEVELAND, OHIO.



THE WEIR FROG CO. CINCINNATI, O. FRED. C. WEIR PRES.

SOLE MANUFACTURERS OF FRED. G. WEIR'S IMPROVED RIGID & SPRING FROGS, CROSSINGS SINGLE & THREE THROW SPLIT SWITCHES. FIXED & AUTOMATIC SWITCH STANDS. STEEL DIE FORMED RAIL BRACES, SWITCH FIXTURES, ETC

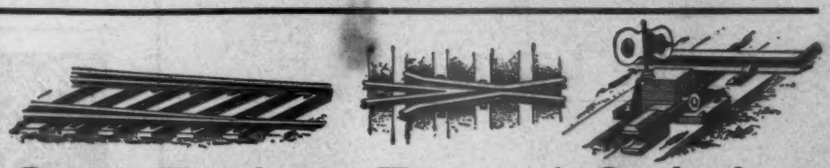
CABLE & ELECTRIC TRACK WORK FROGS, SWITCHES, CROSSINGS, CURVES RAIL CHAIRS ETC

PENNSYLVANIA STEEL CO., STEELTON, PA.

STEEL RAILS. ALL WEIGHTS AND PATTERNS.
SPLICES AND FASTENINGS

Steel Rail Frogs and Crossings, Switches.
Magneto Alarm Signals for Crossings, Semaphores.

PHILADELPHIA OFFICE, 208 So. Fourth St. | NEW YORK OFFICE, No. 2 Wall St. | BOSTON OFFICE, 70 Kilby St.

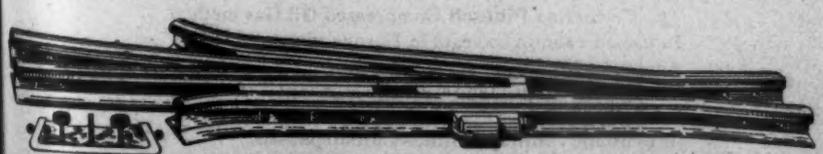


Cars, Engines, Frogs, & Switches,

CARLISLE MFG. CO., Carlisle, Pa.

NEW YORK FROG & SWITCH CO.,

MANUFACTURERS OF

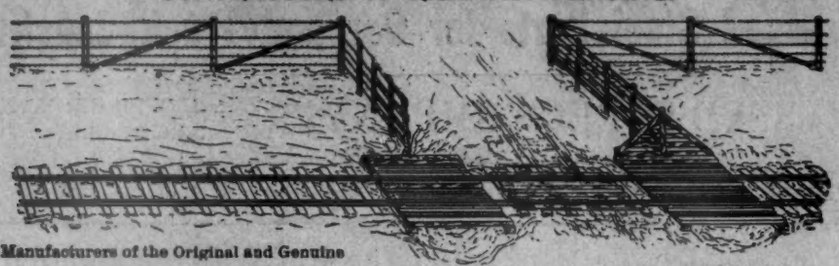


Split Switches, Steel Castings,
Frogs, Crossings,
Automatic Switch Stands,
Also STUB SWITCH FIXTURES.
Special Work for Electric Railways,
Cast Steel Switches and Frogs.

Office and Works: MADISON, 15th & 16th STS., HOBOKEN, N. J.

THE I. L. ELLWOOD MFG. CO., [Established 1873.] DeKalb, Ill.

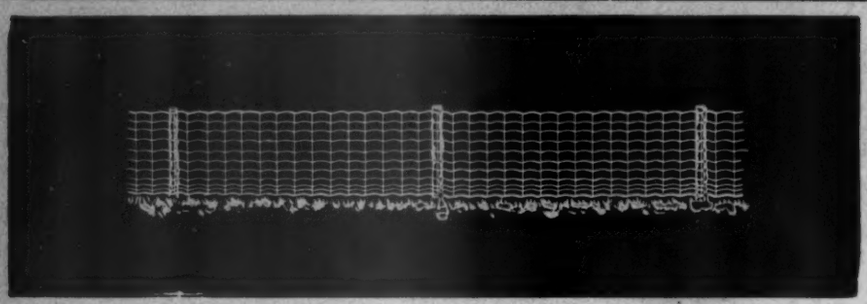
CONTRACTORS OF RAILWAY FENCING.



Manufacturers of the Original and Genuine

GLIDDEN STEEL BARBED FENCE WIRE.

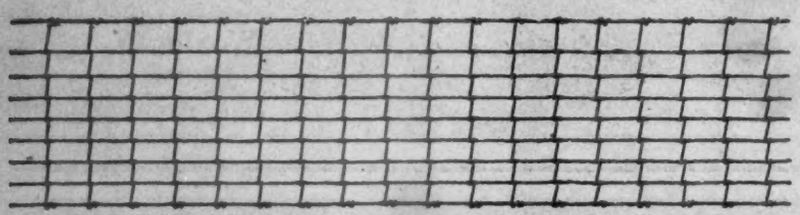
Estimates Promptly Furnished. Correspondence Solicited.



FIRST

For Farms...
For Railroads
Around Parks
and Cemeteries

PAGE WOVEN WIRE FENCE CO., Adrian, Mich.



CABLED FIELD and HOG FENCE, 24 in. to 58 in. high; CABLED POULTRY FENCE, 24 in. to 63 in. high. STEEL WEB PICKET LAWN FENCE, 18 in. to 50 in. high. STEEL WIRE FENCE BOARD and ORNAMENTAL STRIP. Steel Posts, Steel Rail, Steel Gates and Steel Tree, Flower and Tomato Guards. We manufacture a full line of Wire Fencing, Gates and Posts, and solicit your patronage. Catalogue Free. De Kalb Fence Co., 1 High St., De Kalb, Ill.

58-INCH FIELD FENCE, 13 CABLES. THE BEST RAILROAD FENCE MADE.

Bush Cattle Guard Co.,

KALAMAZOO, MICH.,

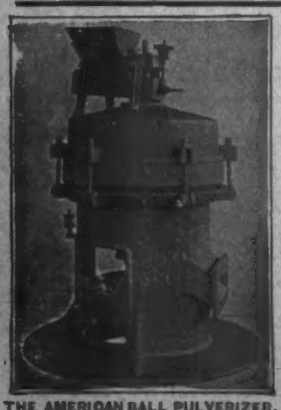
Makes the Best Guard on the Market, the effectual Stock Turner and the Cheapest Guard in the World.

Catalogues upon application. *Correspondence Solicited.*

General Office: KALAMAZOO, MICH.
CHICAGO OFFICE: 1601 Manhattan Building.
—— E. J. EAMES, Agent. ——

Subscribe for the AMERICAN ENGINEER AND RAILROAD JOURNAL.

An Illustrated Bi-weekly Publication Devoted to Mechanical Engineering and Railroad Topics.



THE AMERICAN BALL PULVERIZER.

SPECIALTIES:

Am. Crusher and Am. Ball Pulverizer.

The Simplest, Cheapest and Best Machines in the Market. Pulverize wet or dry to any degree of fineness. Makes little or no slimes in wet nor dust in dry work. Four sizes, capacity from 2 to 60 tons per day.

SEND FOR CATALOGUE.

Cable Address, American.

First Prize and Gold Medal Awarded by World's Fair, 1893.

THE American Mining & Milling Machinery Co.

29 Euclid Ave., CLEVELAND, O. 280 Caxton Block, CHICAGO, ILL.

Office of THE CLEVELAND IRON ORE PAINT CO. and THE GARRY IRON ROOFING CO.,
CLEVELAND, O., Jan. 26, 1894.

The American Mining and Milling Machinery Co., Cleveland, O.:

GENTLEMEN: We purchased a No. 2 American Rock Breaker and a No. 2 American Ball Pulverizer from your company about one year ago. The latter part of April, 1893, we started up for regular work, since which time we have run both of said machines to the full extent of our demands and to our entire satisfaction. The first 700 tons of hard iron ore that we pulverized for paint purposes was ground without taking the Pulverizer apart, and without expending one dollar for repairs for either of these machines. Of the 700 tons spoken of about 500 tons was Lake Superior Specular Iron Ore, containing some 70 per cent. iron; a very difficult ore to pulverize. The remainder was a red fossilliferous iron ore, carrying quite a per cent. of silex, which cuts out buhr stones rapidly. We find that the steel balls, which were when new 5 in. in diameter, now calliper 4¾ in., and are perfectly round and smooth. The grinding track shows very little wear, and the driving track shows less; in fact the wear is almost imperceptible. These two machines crush and pulverize more than one ton per hour with less than 12 H.P. We do not know of any Crusher or Pulverizer that can compare with the output of these two machines in quantity, quality, small amount of wear and tear, and like power. In our opinion you cannot recommend them too highly.

Very truly yours, CLEVELAND IRON ORE PAINT CO.